Final Report

Critical Evaluation of State-of-the-Art In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

ESTCP Project ER-0314

JANUARY 2010

Jennifer Triplett Kingston **Arizona State University**

Paul R. Dahlen **Arizona State University**

Paul C. Johnson **Arizona State University**

Eric Foote **Battelle Memorial Institute**

Shane Williams **Battelle Memorial Institute**

Distribution Statement A: Approved for Public Release, Distribution is Unlimited



maintaining the data needed, and c including suggestions for reducing	lection of information is estimated to ompleting and reviewing the collect this burden, to Washington Headqu uld be aware that notwithstanding and DMB control number.	ion of information. Send commen arters Services, Directorate for Int	ts regarding this burden estimate formation Operations and Reports	or any other aspect of to , 1215 Jefferson Davis	his collection of information, Highway, Suite 1204, Arlington			
1. REPORT DATE JAN 2010		2. REPORT TYPE		3. DATES COVE 00-00-201 0	ERED O to 00-00-2010			
4. TITLE AND SUBTITLE				5a. CONTRACT	NUMBER			
	of State-of-the-Art NAPL Source Zone		Creatment	5b. GRANT NUM	MBER			
Technologies for D	NAI L Source Zone	Treatment		5c. PROGRAM I	ELEMENT NUMBER			
6. AUTHOR(S)				5d. PROJECT N	JMBER			
		5e. TASK NUMBER						
			5f. WORK UNIT NUMBER					
	ZATION NAME(S) AND AIX rersity,411 N. Centr	` '	,AZ,85004	8. PERFORMING REPORT NUMB	G ORGANIZATION ER			
9. SPONSORING/MONITO	RING AGENCY NAME(S) A	AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)				
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)				
12. DISTRIBUTION/AVAIL Approved for publ	LABILITY STATEMENT ic release; distribut	ion unlimited						
13. SUPPLEMENTARY NO	OTES							
14. ABSTRACT								
15. SUBJECT TERMS								
16. SECURITY CLASSIFIC	ATION OF:		17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF			
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	Same as Report (SAR)	1270	RESPONSIBLE PERSON			

Report Documentation Page

Form Approved OMB No. 0704-0188

Acknowledgements

First and foremost, the authors would like to thank the Environmental Security Technology Certification Program (ESTCP) for funding this project and providing constructive technical input as the project progressed. Their understanding of the value of the deliverables from this work to practitioners was essential to this project.

The success of this project also depended on the cooperation and support of many individuals and entities that are too numerous to list. We would, however, like to acknowledge the following for their special efforts:

- Those companies/entities providing support in the data collection phase of research:
 - Current Environmental Solutions
 - ERM
 - Haley and Aldrich
 - McMillan-McGee
 - Shaw Environmental
 - TerraTherm
 - Thermal Remediation Services

- Department of Defense
- Department of Energy
- Air Force
- Navy (NAVFAC)
- National Air Reserve
- US Army Corps of Engineers
- US Environmental Protection Agency
- Those individuals instrumental in helping us identify and/or gain access to field sites and who supported our work at those sites:
 - Ronald Kenyon (Shaw Environmental)
 - Daniel Hood (Navy)
 - Bob Lowder (Marines)
 - Steven Peck (Navy)
 - Doug Delong (Navy)
 - John McGuire (Shaw)
 - George Walters (Air Force)

- Richard Wice (Shaw Environmental)
- Randall McDaniel (Shaw Environmental)
- Phil La Mori (BEM Systems)
- Mark Kershner (Air Force)
- Emile Pitre (USACE)
- Kira Lynch (USACE)
- Algeana Stevenson (DPW Environmental)
- Those individuals who provided support throughout many phases of this project:
 - Eva Davis (USEPA)
 - Ralph Baker (Terra Therm)
 - Gorm Heron (Terra Therm)
 - John LaChance (TerraTherm)
 - Dave Becker (USACE)
 - Sam Yoon (formerly Battelle)
 - Glenna Clark (Navy)
 - Gerry Hromowyk (National Air Reserve)

- Tony Landler (SCE)
- Ray Kasevich (KAI)
- Derek Peacock (URS)
- David Rountree (WRS)
- David Scaturo (SC DHEC)
- David Ingle (DOE)
- Dacre Bush (formerly McMillan McGee)
- Craig Holloway (URS)
- Denis Conley (Haley & Aldrich)

Finally, we would like to extend a special thanks to the following individuals who authored state-of-the-art descriptions for the most common in-situ thermal technologies currently employed:

• Electrical Resistance Heating - Greg Smith (Thermal Remediation Services, Inc.)

Thermal Conduction Heating Gorm Heron (TerraTherm)
 Ralph Baker (TerraTherm)

Steam Enhanced Extraction Gorm Heron (TerraTherm)
 Gregory Crisp (TerraTherm)

 Hot Air/Steam Injection Using Large Diameter Auger (LDA) In-Situ Mixing -Phil La Mori (BEM Systems, FECC Corporation)
 Elgin Kirkland (FECC Corporation)

Executive Summary

In-situ thermal soil and aquifer remediation technologies (e.g., electrical resistance heating, conductive heating, steam-based heating, etc.) have undergone rapid development and application in recent years. These technologies offer the promise of more rapid and thorough treatment of non-aqueous phase liquid (NAPL) source zones; however, their field-scale application has not been well-documented in the technical literature.

In this project, the performance of thermal technologies for DNAPL source zone remediation was assessed with particular emphasis on post-treatment groundwater quality and mass discharge (sometimes referred to as "mass flux"). This critical evaluation involved an empirical analysis of available design and operating information and performance results from pilot- and full-scale applications to see what experiences to-date have been. This was supplemented with post-treatment field sampling at selected sites to fill data gaps. This project was complementary to, and made use of knowledge gained from other ESTCP and SERDP projects that were looking at relationships between DNAPL architecture, treatment effectiveness, and groundwater mass discharge (flux).

Documents from 182 applications were collected and reviewed, which included 87 electrical resistance heating, 46 steam-based heating, 26 conductive heating, and 23 other heating technology applications conducted between 1988 and 2007. Approximately 90% of the 182 applications were implemented after 1995 and about half since 2000. More specifically, this review identified the geologic settings in which these technologies were applied, chemicals treated, design parameters, operating conditions, and performance metrics. The results of this study are summarized in a set of summary tables (spreadsheet-based tables) linking this information to five generalized geologic scenarios. The Summary Tables can be used by practitioners, regulators, and site owners to anticipate the likely performance of thermal-based DNAPL treatment technologies at their sites. The tables provide a tool where performance experience and theoretical bounds on performance expectations are linked to a small number of generalized geologic scenario site descriptors. The user can choose the generalized scenario that most closely resembles their site and can quickly assess:

- a) how the technology has been applied to date in that type of setting,
- b) the designs employed,
- c) the operating conditions,
- d) the performance monitoring that results are based on,
- e) the performance observed,
- f) indicators of success at other sites, and
- g) reasonable bounds on expected performance.

The two summary tables are the Overall Data Summary Table and the Site-Specific Summary Table. The Overall Data Summary table provides a summary of the thermal application since 2000, while the Site-Specific Summary Table provides all the background information acquired for each site for a detailed summation of any site of interest to the user.

Additional data for these Summary Tables were gained by performing post-treatment groundwater sampling at sites where a full-scale thermal application was applied aggressively. By aggressively, we mean attaining temperatures greater that 90°C and maintaining that for at least three days. The post-treatment groundwater sampling was performed after the groundwater was allowed to cool to pre-treatment temperatures and move through the treated zone to see what residual contamination may have been left after treatment. These groundwater impacts were quantified by dissolved concentrations and mass flux (discharge) into the aquifer which were obtained through high spatial density sampling at five thermal treatment sites. The range of concentration and mass flux reductions ranged from about <10X to 1000X, and was strongly linked to how well the source zone was delineated prior to treatment.

Another product of this work is the document *State-of-the-Practice Overview of the Use of In Situ Thermal Technologies for NAPL Source Zone Cleanup*. It is intended to be a useful tool and primer for program managers considering the use of thermal technologies at their sites. It contains the results of this work, but in a more condensed format prepared for the program manager audience.

Table of Contents

1.0	INTE	ODUCTION	1
	1.1	BACKGROUND	1
	1.2	OBJECTIVE OF THE DEMONSTRATION	1
	1.3	REGULATORY DRIVERS	2
2.0	TEC	HNOLOGY	
	2.1	TECHNOLOGY DESCRIPTION	
	2.2	ADVANTAGES AND LIMITATIONS OF THE TECHNOLOGY	4
3.0	PERI	FORMANCE OBJECTIVES	5
4.0	SITE	DESCRIPTION	9
	4.1	SITE SELECTION	
	4.2	SITE LOCATION AND HISTORY	
	4.3	SITE GEOLOGY/HYDROGEOLOGY	
	4.4	CONTAMINANT DISTRIBUTION	13
5.0	TEST	DESIGN	
	5.1	CONCEPTUAL EXPERIMENTAL DESIGN	
	5.2	BASELINE CHARACTERIZATION	
	5.3	TREATABILITY OR LABORATORY STUDY RESULTS	
	5.4	DESIGN AND LAYOUT OF TECHNOLOGY COMPONENTS	16
	5.5	FIELD TESTING	
	5.6	SAMPLING AND ANALYTICAL METHODS	16
	5.7	SAMPLING RESULTS	19
6.0	PERI	FORMANCE ASSESSMENT	23
	6.1	EMPIRICAL DATA COLLECTION AND SYNTHESIS WITH	
		EMPHASIS ON SETTING, DESIGN, AND OPERATING	
		CONDITIONS	23
	6.2	EMPIRICAL DATA COLLECTION AND SYNTHESIS WITH	
		EMPHASIS ON PERFORMANCE (GROUNDWATER QUALITY	
		AND MASS DISCHARGE CHANGES)	31
	6.3	SUMMARY OF KEY OBSERVATIONS	33
7.0	IMPI	LEMENTATION ISSUES	36
8.0	REFI	ERENCES	37
9.0	APPI	ENDICES	38
APPI	ENDIX	A Points of Contact	
	ENDIX	<i>27</i> 1	
APPI	ENDIX	\mathcal{E}	
APPI	ENDIX		and
		Data Analysis Reports	
APPI	ENDIX		
APPI	ENDIX	F Uncertainty Analysis for Mass Discharge Calculations	

List of Figures

Figure 1. Sample of Overall Data Summary Table
Figure 2. Sample of Site-Specific Summary Table
Figure 3. Site Locations for Supplemental Investigations
Figure 4. Generalized Geologic Scenarios
List of Tables
Table 1. Performance Objectives
Table 2. Site Geology, Hydrogeology, and Treatment Area Information
Table 3. Sampling Transect Widths at the Supplemental Field Sites
Table 4. Sampling Methods
Table 5. Groundwater Sample Collection Procedures
Table 6. Mass Discharge Sampling Transect Details for Supplemental Site Investigations 21
Table 7. Total Number and Types of Samples Collected ¹
Table 8. Range of Permanent Monitoring Well Pre- and Post-Treatment Concentration Data
(ug/L)
Table 9. Summary of Mass Discharge (Mass Flux) Calculations at Field Investigation Sites 23
Table 10. Summary of Technology Applications by Technology Type
Table 11. Characterization of the Data Available from the 182 Applications Reviewed 28
Table 12. Basic Design Information Compiled for all Sites Reviewed
Table 13. Basic Operating Conditions Summary for all Applications Reviewed
Table 14. Summary of Key Information Gathered from Reviewed Applications Conducted
Since 2000
Table 15. Summary of Source Zone Dissolved Groundwater Concentration and Mass
Discharge Reductions Achieved at Sites with Sufficient Data to Perform this
Analysis
Table 16. Summary of Mass Discharge Estimates for Sites with Sufficient Data

List of Acronyms

AFP4 Air Force Plant 4

ASU Arizona State University
bls Below land surface
bgs Below ground surface

BTEX Benzene, toluene, ethylbenzene, xylene

°C Degree Celsius

CAH Chlorinated aliphatic hydrocarbon
DELCD Dry electrolytic conductivity detector
DNAPL Dense non-aqueous phase liquid

DO Dissolved oxygen
DoD Department of Defense

DRMO Defense Re-utilization Marketing Office

EGDY East Gate Disposal Yard

EPA Environmental Protection Agency

ERH Electrical resistance heating

ESTCP Environmental Security Technology Certification Program

FID Flame-ionization detector

ft Feet/foot g / gm Gram

HAAF Hunter Army Airfield HASP Health and Safety Plan HCl Hydrochloric acid

in inch

ISTD In situ thermal desorption

L Liter

LNAPL Light non-aqueous phase liquid

M Meter

MCB Marine Corps Base

mg Milligram ml Milliliter

NAPL Non-aqueous phase liquid

NAS Naval Air Station

NRC National Research Council
ORP Oxidation reduction potential

PAH Poly-nuclear aromatic hydrocarbons

PID Photo-ionization detector

QA Quality assurance QC Quality control

RFH Radio frequency heating SEE Steam enhanced extraction

SERDP Strategic Environmental Research and Development Program

TCE Trichloroethylene

ug Microgram ul Microliter USEPA

United States Environmental Protection Agency Volatile organic analysis Volatile organic compound VOA VOC

1.0 INTRODUCTION

1.1 BACKGROUND

Dense nonaqueous-phase liquid (DNAPL) source zone treatment is one of the most significant remediation challenges facing the Department of Defense (DoD) and the private sector. As a result, the number of in situ cleanup technologies developed and tested at DNAPL sites has increased in recent years. Approaches that employ increased temperature, chemical oxidation, surfactant flushing, and biological degradation processes have been developed and applied with varying degrees of success.

More recent critical review of the data from many of these sites has revealed that even with the most recent advancements in application of these treatment technologies, complete DNAPL source removal is unlikely. Hence, residual DNAPL after aggressive technologies have achieved their effective endpoints are expected to continue to have an impact on groundwater quality.

This project is focused on thermal-based technologies (e.g., resistive heating, conductive heating, steam-based heating) for DNAPL source treatment and a critical assessment of the potential performance of these technologies as measured by conventional and mass flux metrics. Thermal technologies are of interest because of their rapid development in recent years and because of vendor claims that they offer unique advantages over competing technologies. In particular, it is claimed that thermal technology performance is less hindered by geologic stratification and other sources of mass-transfer resistances than other flow-based technologies applied to DNAPL source zones (such as surfactant flushing, chemical oxidation, and in situ sparging).

This project is complementary to other ESTCP and SERDP projects that are looking at relationships between DNAPL architecture, treatment effectiveness, and groundwater mass discharge (flux). It is unique from the other projects in that the final report will tie together a combination of results from empirical analyses of available field data and project-specific field sampling at target sites.

It is important to note that this project is unlike other ESTCP projects in that it does not involve the field demonstration of a particular technology nor is it linked to any specific site(s). This document, therefore, is non-site-specific, and while it does focus on thermal-based DNAPL treatment technologies, it is non-technology specific.

1.2 OBJECTIVE OF THE DEMONSTRATION

In this project, the performance of thermal technologies for DNAPL source zone remediation was assessed through compilation and critical review of data available from pilot- and full-scale applications. Particular emphasis was placed on gaining a better understanding of settings in which thermal technologies have been applied, the design and operating conditions that were used, and the performance of the systems. With respect to the latter, particular emphasis was placed on post-treatment groundwater quality and source zone residual mass discharge to the aquifer (commonly referred to as "mass flux"). This critical evaluation was supplemented with

post-treatment field sampling at selected sites to fill data gaps. This project was complementary to and made use of knowledge gained from other ESTCP and SERDP projects that were looking at relationships between DNAPL architecture, treatment effectiveness, and groundwater mass discharge (flux).

Included with this report are Summary Tables (spreadsheet-based tables) that can be used by practitioners, regulators, and site owners to anticipate the likely performance of thermal-based DNAPL treatment technologies at their sites. Each table is a tool where application and performance experience are linked to a small number of generalized geologic scenario site descriptors. The user can choose the generalized scenario that most closely resembles their site and can quickly assess:

- a) how the technology has been applied to date in that type of setting,
- b) the designs employed,
- c) the operating conditions,
- d) the performance monitoring that results are based on, and
- e) the performance observed.

1.3 REGULATORY DRIVERS

Regulatory agencies at the federal, state, and local levels generally have groundwater quality concentration-based metrics that necessitate treatment or containment of DNAPL source zones. Thermal treatment technologies, which have undergone significant development in the past decade, present innovative options for source zone treatment.

2.0 TECHNOLOGY

This project does not involve the demonstration of a developing technology, as is common for most ESTCP projects. Rather, it seeks to supplement our understanding of existing thermal treatment technologies through the development of a practicable tool in which performance experience and theoretical bounds on performance expectations are linked to a small number of generalized scenario site descriptors. This section describes in situ thermal technology development and use.

2.1 TECHNOLOGY DESCRIPTION

The history of in situ thermal technology development and use is summarized in the United States Environmental Protection Agency (USEPA), March 2004 report, *In Situ Thermal Treatment of Chlorinated Solvents: Fundamentals and Field Applications*. In brief, most in situ thermal cleanup technologies originate from thermal heating technologies developed for enhanced oil recovery applications. In the past two decades, the understanding of in situ heating and fluid recovery gained from enhanced oil recovery applications has been applied to hazardous waste site cleanups.

The in situ thermal technologies which are most commonly used and for which data were available include steam-based heating (sometimes referred to as steam-enhanced extraction), conductive heating (sometimes referred to as in situ thermal desorption), electrical resistance heating (sometimes referred to as six- or three-phase heating), radio-frequency heating, and insitu soil mixing with large diameter augers combined with steam and hot air injection. Each of these technologies relies on heat to enhance the removal and treatment of contaminant vapors and liquids from the subsurface. Depending on operating temperatures, heating may decrease contaminant liquid viscosity, decrease interfacial tension, increase biodegradation rates, increase solubility, and/or increase volatility. What differentiates one technology from the next is the method of heating or energy delivery, for example: steam injection, resistive heating by passing a current through the soil between electrodes, conductive heating accomplished by heat conduction away from in situ heating elements, and radio frequency heating from radio waves. Detailed descriptions of these technologies along with vendor supplied state-of-the-practice reports (with the exception of radio-frequency heating which has had limited application) are provided in Appendix B and can also be found in greater detail in Triplett Kingston (2008).

The approach used in this study to summarize data on the application and performance of in-situ heating technologies (i.e., performance experience and theoretical bounds on performance expectations linked to a small number of generalized scenario site descriptors) was similar to that employed in the NRC 2004 report *Contaminants in the Subsurface: Source Zone Assessment and Remediation*. The approach, as it pertained to this project, was to identify sites where thermal technologies had been applied and to collect and compile site characterization and in situ thermal design, operation, and treatment data from each. Although 180 in situ thermal applications were identified, acquisition of detailed application and performance data was difficult and of varying quantity and quality.

For each in situ thermal application studied, data collection focused on:

- Setting (geology, depth to groundwater, source zone boundaries, chemicals present, etc.),
- System design parameters (number of energy delivery points, area and depth of the treatment zone, etc.),
- Operating conditions (temperature achieved, duration of treatment, duration of monitoring, etc.), and,
- Performance data (emphasizing improvement in groundwater quality and reduction in mass discharge of contaminant to the aquifer).

To streamline data collection and maintain consistency of the data collected from each site, data logs were used. Data logs are shown in Appendix C.

Data reduction involved interpretation and the use of professional judgment, especially when comparing pre- and post-treatment groundwater impacts. To simplify data reduction and remain consistent with the typical quality and quantity of available data, performance data were quantified only in terms of order-of-magnitude reductions in groundwater concentrations and source zone mass discharges.

Results were compiled in tables in a manner thought to be useful to practitioners that might be interested in evaluating thermal treatment options for their sites and who would benefit from this empirical compilation of historical data.

2.2 ADVANTAGES AND LIMITATIONS OF THE TECHNOLOGY

Thermal technologies are attractive because of potentially shorter treatment times (weeks or months, rather than years for many other technologies) and lower total operations and maintenance costs. Only energy, and in some cases water and air, are added to the subsurface, rather than chemicals or bio-amendments.

In situ thermal technologies are thought to have advantages relative to other remedial options, including: (1) shorter operation times, (2) many chemicals can be treated at once, and (3) some thermal technologies, ERH and conductive heating in particular, are less sensitive to subsurface heterogeneities across a site.

The potential drawbacks of use of in situ thermal technologies include the following: (1) they are difficult to apply near occupied/active sites; (2) they require more sophisticated design and operation; (3) they may enhance the potential for contaminant to migrate to previously non-impacted areas; and (4) post-treatment soil temperatures may remain elevated for prolonged periods of time (months to years).

In addition, poor documentation and a lack of quantitative post-treatment performance data has made it difficult to confidently define practicable performance expectations for thermal technologies.

3.0 PERFORMANCE OBJECTIVES

The performance objectives for this project are captured below in Table 1.

Table 1. Performance Objectives

Performance Objective	Data Requirements	Success Criteria	Results						
Quantitative Performance Objectives									
Collect data on in-situ thermal applications Data on hydrogeologic setting, type and method of application, temperature data, and estimate of contaminant reduction		Ability to obtain documentationData exists in documentation	Summary table of relevant data.						
Qualitative Performance	e Objectives								
Assess Groundwater Quality and Mass Discharge	Assess Groundwater Quality and Mass Groundwater concentration data and groundwater velocity		Summary tables of concentration and mass discharge data.						

Developing the Preliminary Assessment Tool involved the following tasks:

- Task 1 Data collection, review, and compilation of historical performance data: Using professional judgment, application and performance data were reduced, linked to idealized geologic conceptual models, and summarized in user-friendly performance summary tables.
- Task 2 Supplemental post-treatment field investigations performed at sites identified in Task 1: Sites were chosen to best augment the information compiled in Task 1.

More detailed discussions of the technical approach for each task are given below.

Task 1 - Data Compilation, Interpretation, and Capture in Tables: The objective of this task was to compile and review DNAPL source zone treatment/characterization experiences at existing field sites by mining historic data from sites where a thermal treatment had been applied. Data requirements needed to support the review of thermal treatment applications and to develop and classify the sites into the idealized conceptual models included:

- subsurface and hydrogeologic characteristics (generalized geologic descriptions, groundwater flow direction, hydraulic conductivity),
- pre-treatment characterization data (chemical concentrations and distribution, source area, DNAPL mass estimates, etc.),
- technology implementation,
- DNAPL removed and measurement methods,
- DNAPL mass and/or distribution remaining after treatment.
- dissolved contaminant concentrations in and down gradient of the source zones (preferably over a period of time sufficient to evaluate rebound),
- remedial action objectives,

- post-treatment status of the source-zones/sites (e.g., monitored natural attenuation with long-term monitoring, pump-and-treat with institutional controls, closure), and
- treatment costs incurred.

Efforts during this project focused on identifying sites where thermal technologies had been applied and collecting as much of the available data listed above for those sites. It was found that thermal technologies have been applied at numerous sites but obtaining detailed site characterization and treatment/performance data for the thermal application was difficult as it was either not collected or not reported for many sites. Through considerable effort, data of varying quantity and quality was obtained for 182 thermal sites.

A preliminary review of the data revealed that database compilation would require more professional judgment and interpretation of the data than initially anticipated. Also, the construction of the database needed to be an iterative process that resulted in a final database structure reflective of the type of information contained in the reports. Because of these issues, it was critical that all key project personnel were engaged in this activity on an on-going basis.

Sample Summary Tables are shown below in Figures 1 and 2.

Task 2 - Supplemental Field Investigations at Thermal Treatment Sites: This task involved the collection of field data from sites that had undergone thermal treatment and for which sufficient time had elapsed to allow the subsurface environment to return to pre-treatment conditions. Supplemental data collection focused on assessing groundwater impacts as quantified by dissolved concentrations and source zone discharge (mass flux) to the aquifer following an in situ thermal treatment for NAPL removal. Site selection was based on available data and priorities for data augmentation in the summary tables, idealized conceptual models (that all results were tied to), the frequency of occurrence of site type in the broader database population of sites, and supplemental data needs identified from the database analysis.

Once the sites were selected, approvals were sought for site access, demonstration plans were prepared for each site, site investigations were performed, and field data reports were issued.

Scenario	Technology	# of Sites	# of Pilot Tests	# of Full- Scale Systems	Name(s) of Best Studied Site(s)	Achiev	ed in	erature Target : Zone			reatment perature	Treatment Monitoring			Discharge		t Mass	Estimated Reduction in Mass Discharge			Criteria Used to Assess Success
						Low [C]	to	High [C]	Low [days]	to	High [days]	Low [days]	to	High [days]	Low [gm/d]	to	High [gm/d]	Low [%]	to	High [%]	see footnotes
Generalized Scenario A: relatively homogeneous and	Steam Heating						П														
permeable unconsolidated	Resistance Heating						\Box														
sediments (mixtures of sands, gravels and silts, etc.)	Other						П														
Generalized Scenario B:	Steam Heating																				
relative homogeneous and relatively impermeable	_						\top			H									H		
unconsolidated sediments	Resistance Heating						+			\vdash			+						\vdash		
(clays, silty clays, etc.)	Other						\vdash														
Generalized Scenario C:	Steam Heating																				
largely permeable sediments with interbedded lenses of	Resistance Heating																				
low permeable material	Other																				
Generalized Scenario D:	Steam Heating						П			П			Т			П			П		
largely impermeable sediments with interbedded	Resistance Heating						\Box			Ħ			T						П		
layers of higher permeable material	Other																				
Generalized Scenario E:	Steam Heating						П												П		
competent, but fractured	Resistance Heating																				
bedrock	Other																				
	Steam Heating						П			П						П			П		
Generalized Scenario F: weathered bedrock	Resistance Heating						П														
	Other																				
<u> </u>	Steam Heating																				
Generalized Scenario G:	Resistance Heating						П														
	Other						\Box														
Footnotes:							+														
1- concentration reduction in e			k																		
2 - asymptotic performance limi	t of treatment system	1																			
3 - mass discharge reduction																					
4 - mass removal criteria																					

Figure 1. Sample of Overall Data Summary Table

Technology	Site Name	Geology at This Site is Most Like Scenario 	Applied	Pilot Test?	Full- Scale System?	# of Energy Delivery Points (wells or electrodes)	Size of Target Treatment Area	Thickness of Target Treatment Interval	Depth to Top of Treatmnent Zone		Peak Temperature in Target Treatment Zone	Duration of Treatment at Peak Temperature	Duration of Post- Treatment Monitoring	Treat		it Mass			eduction charge	Criteria Used to Assess Success
							[ft²]	[ft]	[ft BGS]	[ft]	[C]	[days]	[days]	Low [gm/d]	to	High [gm/d]	Low [%]	to	High [%]	[see footnotes]
	Site #1						[IC]	Lici	[10 000]	[IL]	[0]	[days]	[days]	[gm/a]	+	[giii, d]	[,0]	+	[70]	loothotesj
	Site #2																	\top		
Steam Injection	Site #3																			
															-					
	Site #27															$\overline{}$				
	Site #27 Site #28														+			+		
Electrical Resistance Heating	Site #29														+	\longrightarrow		+		
	Site #29															-		+		
	Site #62																			
	Site #63																			
Other Thermal Treatments	Site #64																			
																\longrightarrow		\perp		
																-				
Scenario Descriptors (for the	 target treatment	zone)																		
A - relatively homogeneous ar	nd permeable unc	onsolidated s	sediments	s (sands	, etc.)															
B - relative homogeneous and)														
C - largely permeable sedimen																				
D - largely impermeable sedim		dded layers o	of higher	permeal	ole materia	al														
E - Competent, but Fractured	Bedrock																			
F - Weathered Bedrock																				
Footnotes - Success Criteria:															-					
1- concentration reduction in	existing monitorin	ng well netwo	ork																	
2 - asymptotic performance li																				
3 - mass discharge reduction		•																		
4 - mass removal criteria																				

Figure 2. Sample of Site-Specific Summary Table

4.0 SITE DESCRIPTION

As indicated previously, this ESTCP project does not involve the demonstration of a developing technology. Rather, it seeks to supplement our understanding of existing thermal treatment technologies. This was accomplished in two tasks: Task 1) Data Compilation, Interpretation, and Capture in Tables; and Task 2) Supplemental Field Investigations at Thermal Treatment Sites. The former involved an empirical analysis of existing data and is therefore not relevant to this section; the latter involved field data collection and is therefore the focus below.

4.1 SITE SELECTION

The following were considerations when selecting candidate sites for supplemental field investigations:

- Sufficient post-treatment time had elapsed for subsurface temperatures to return to pretreatment conditions;
- Priorities for augmenting performance summary tables and supplemental data needs indentified from the database analysis from data collection and the empirical analysis of sites; and,
- Conceptual model types and the frequency of occurrence of each type of site in the broader database population of sites.

In addition, it was preferable that sites had the following characteristics:

- The hydrogeology of the site was reasonably well-characterized (flow direction, depth to groundwater, hydraulic properties and changes with depth are known semi-quantitatively, etc.):
- The aerial extent of the source zone was reasonably defined prior to treatment;
- The depth to groundwater was less than 20 ft;
- The total depth to impacted groundwater was less than 40 ft;
- There was access immediately down-gradient of the treatment zone for drilling and additional site investigation;
- Direct-push technology could be used for drilling/sampling purposes; and,
- Local site personnel were present to facilitate the logistics associated with the sampling events.

Brief descriptions of all the sites are provided below. For more detailed information, Appendix D provides full descriptions of each site.

4.2 SITE LOCATION AND HISTORY

Four sites were selected for supplemental data collection and investigation of post-treatment groundwater quality. These sites and a brief history for each are shown below while Figure 3 shows the location for each on a map of the continental United States:

1) Site 89, Camp LeJeune, Jacksonville, North Carolina:

<u>History:</u> Site 89 at the Camp Geiger portion of Marine Corps Base (MCB) Camp LeJeune was used primarily as a storage yard for the Defense Re-utilization Marketing Office (DRMO) until June 2000.

<u>Treatment History:</u> Electrical resistive heating (ERH) was selected as the technology to remove DNAPL. The system consisted of 43 deep heating electrodes installed to a depth of 26 ft below ground surface (bgs) and 48 shallow heating electrodes installed to a depth of 19 ft bgs. The system was operated from September 2003 until the beginning of May 2004. The remedial system performance was continuously monitored during operation, and an estimated 48,000 pounds of volatile organic compound (VOC) contamination were removed in recovered volatile vapors and 428 pounds of chlorinated compounds were recovered from the groundwater during the application. After the shutdown of the system, the monitoring well network was monitored for one year.

- 2) Building 5, Site 5-1, Naval Air Station (NAS) Alameda, Alameda, California:

 History: Building 5 housed specialty shops for aircraft component repair and maintenance from 1942 until the base was closed in April 1997. Chemical contaminants from the various industrial processes inside Building 5 are believed to have been released directly to the subsurface beneath certain operational areas.

 Treatment History: A pilot scale electrical resistive heating (ERH) application was performed in June of 2002. Based on the results of the pilot, a full-scale system was installed and operated. The system consisted of 7 electrodes installed to a depth of 19 ft bgs and 28 electrodes installed to a depth of 14 ft bgs and 1 electrode installed to 15 ft bgs. The full-scale system was operated from July 2004 until November 2004. The remedial system performance was continuously monitored during operation, and an estimated 3,000 pounds of volatile organic compound (VOC) contamination were removed in recovered volatile vapors and groundwater. After the shutdown of the system, the monitoring well network was monitored for four months.
- 3) Building 181, Air Force Plant 4 (AFP4), Ft. Worth, Texas

<u>History:</u> Building 181 is part of a mile long structure designed for aircraft production. The primary contaminant at Building 181 is trichloroethylene (TCE). The TCE source is believed to be degreaser tanks in Building 181, which have since been removed. Several subsequent investigations found that releases of TCE had migrated through cracks in the concrete building floor resulting in contamination in the saturated and unsaturated zone.

<u>Treatment History:</u> A pilot scale six-phase electrical resistance heating (ERH) application was performed completed in the winter of 2001. Based on the results of the pilot, a full-scale three-phase electrical resistance application was performed in Building 181 in 2002. The full-scale system consisted of 73 electrodes installed to a depth of 32 ft bgs, including 7 electrodes from the pilot-scale test and 2 electrodes installed during operation to enhance heat generation in target areas. The full-scale system was operated from May 2002 until December 2002. The remedial system

performance was continuously monitored during operation, and an estimated 1,417 pounds of TCE was removed via steam and vapor extraction systems. The treatment area has been monitored semi-annually since the system was shut down in 2002.

4) Former Pumphouse No. 2, Hunter Army Airfield (HAAF), Savannah, Georgia **History:** Former Pumphouse No. 2 at Hunter Army Airfield (HAAF) was an aviation-gas fuel island that was used from 1953 until the early 1970s. During previous investigations, petroleum contaminates were identified in the soil and groundwater, including benzene, toluene, ethylbenzene, and xylenes (BTEX), as well as polynuclear aromatic hydrocarbon (PAH) constituents in the form of free product light non-aqueous phase liquid (LNAPL). The LNAPL source area was determined to be approximately 11,500 square feet (ft²) by the time the ERH application was performed.

<u>Treatment History:</u> During the previous investigations, free product was identified. It was recommended that electrical resistance heating (ERH) be implemented to remove the free product. The system consisted of 111 electrodes installed to a depth of 16 ft below ground surface (bgs) with the conductive interval set from 8 to 16 ft bgs. A full-scale ERH system was operated from March 2002 until July 2002. After shutdown, the piezometers installed for the ERH application were left in place and are still being sampled semi-annually.

Supplemental data collection was also performed at a fifth site, Ft. Lewis East Gate Disposal Yard Area 3, Ft. Lewis, Washington. Data collection differed at the Ft. Lewis East Gate Disposal Yard since it was a real-time evaluation of a thermal treatment to evaluate the concurrent and post-treatment groundwater response. A brief summary of Ft. Lewis East Gate Disposal Yard shown below and Figure 3 shows its location:

5) Ft. Lewis East Gate Disposal Yard Area 3, Ft. Lewis, Washington **History:** Ft. Lewis was initially developed as a Logistics Center in April 1942, but was transferred to ordnance jurisdiction in August 1942. It operated as an ordnance depot until 1963 when the area was turned back over to the Logistics Center to serve as the primary non-aircraft maintenance facility for Ft. Lewis. The main degreasing agent used at this facility until the mid-1970s was Trichloroethylene (TCE) when it was replaced with 1,1,1-trichloroethane (1,1,1-TCA). The waste TCE was disposed of with waste oils at several locations including the East Gate Disposal Yard (EGDY). The EGDY was used between 1946 and the mid-1970s as a waste disposal site storing barrels and vats in trenches around the yard. **Treatment History:** The remedial investigations identified free product interspersed throughout the soil matrix mainly in the form of ganglia and globules. It was recommended that electrical resistance heating (ERH) be implemented to remove the free-phase product and optimize the existing groundwater pump-andtreat system. The system consisted of 93 electrodes installed to a depth of 30 ft below ground surface (bgs) with the conductive interval set from 0 to 30 ft bgs. The third full-scale ERH system at the EGDY was operated from October 2006 until January 2007. After shutdown, the monitoring wells installed for the ERH

application were left in place and are still being sampled throughout the cool-down process and then will continue to monitored quarterly.



Figure 3. Site Locations for Supplemental Investigations

4.3 SITE GEOLOGY/HYDROGEOLOGY

Table 2 below provides pertinent information regarding the site geology/hydrogeology for each supplemental data collection site. In addition, the table includes information regarding the thermal treatment applied at each.

Table 2. Site Geology, Hydrogeology, and Treatment Area Information.

Site ID	Technology	Geology at This Site is Most Like This Conceptual Scenario ¹	Number of Permanent Monitoring Wells	Type of Chemicals Treated (C-chlorinated solvents, P-petroleum hydrocarbons, W-Wood-treating, O-other)	Size of Target Treatment Area [ft²]	Thickness of Target Treatment Interval [ft]	Depth to Water [ft]
Hunter Army Airfield Former Pumphouse #2	ERH	A	12	P, O	30,000	8	13
Air Force Plant 4 Bldg. 181	ERH	В	21	С	21,780	37	30
NAS Alameda Building 5, Site 5-1	ERH	С	15	С	14,520	20	6
Ft. Lewis EDGY Area 3	ERH	С	17	C, P	18,200	30	N/A
Camp LeJeune Site 89	ERH	С	26	С	15,873	21	5

¹Scenario Descriptors (for the target treatment zone)

ERH - Electrical resistance heating

N/A - Not Available

4.4 CONTAMINANT DISTRIBUTION

Field investigations associated with this project focused on post-treatment groundwater sampling across a transect perpendicular to groundwater flow and immediately down-gradient of the treatment zone at each site. The lateral and vertical distributions of contaminants in groundwater were determined at each site by on-site chemical analyses conducted as samples were collected. The width of each transect is given in Table 3 below.

A - relatively homogeneous and permeable unconsolidated sediments (sands, etc.)

B - largely impermeable sediments with interbedded layers of higher permeable material

C - largely permeable sediments with interbedded lenses of low permeable material

D - Competent, but fractured bedrock

E - Weathered Bedrock

Table 3. Sampling Transect Widths at the Supplemental Field Sites.

Site ID	Treatment Zone Width Perpendicular to GW Flow (ft)	Comments
Hunter Army Airfield Former Pumphouse #2	400	Documentation indicated quasi radial groundwater flow from the source zone, likely the result of drainage to a doglegged drainage ditch adjacent to the site.
Air Force Plant 4 Bldg 181	170	Flow direction based on groundwater contour maps and contaminant distribution from site documentation.
NAS Alameda Building 5, Site 5-1	115	Flow direction based on groundwater contour maps and site documentation.
Ft. Lewis EGDY Area 3*	110	Flow direction based on groundwater contour maps and site documentation.
Camp LeJeune Site 89	255	Flow direction based on groundwater contour maps. However, site constraints would require a transect with an approximate 30 degree angle, the apex of which was directly downgradient of source zone.

5.0 TEST DESIGN

As in Section 4.0, this section focuses on the supplemental field investigation component of this project.

5.1 CONCEPTUAL EXPERIMENTAL DESIGN

The goal of the supplemental field investigations was to collect sufficient groundwater and aquifer characterization data to assess post-treatment groundwater quality and mass discharge immediately down-gradient of source zone areas where an in situ thermal remediation had been applied. Data determined necessary for a competent evaluation of the site included the following: 1) depth-specific groundwater quality data and aquifer characterization data along a transect down-gradient of the source zone and perpendicular to the groundwater flow direction; 2) groundwater quality data and aquifer characterization data from monitoring wells in and adjacent to the source/treatment zone; 3) soil core collection to confirm geologic conceptual model; and 4) depth to water measurements for flow direction and gradient.

To accomplish the goal described above, the following field activities were undertaken:

- Groundwater sampling and aquifer characterization at depth-discrete sampling points along a transect down-gradient of the treatment zone and perpendicular to the direction of groundwater flow,
- Groundwater sampling and aquifer characterization at select monitoring wells in or adjacent to the treatment zone, and
- Analysis of water samples for general chemistry and hydrocarbon concentrations.

Aquifer characterization involved the following activities:

- Aquifer specific-capacity tests or slug tests of both depth-discrete sampling points along transects and permanent monitoring wells,
- Depth to water measurements, and
- Soil core collection.

These activities were conducted at Hunter Army Airfield, Air Force Plant 4, NAS Alameda Bldg. 5, and Camp LeJeune Site 89. The Ft. Lewis EGDY site supplemental data collection involved analysis of groundwater samples collected from permanent monitoring wells (shipped to ASU by Army Corps of Engineers personnel). Samples were collected during 16 sampling events over a 1.5 year time frame, and included pre-, concurrent-, and post-treatment sampling events.

5.2 BASELINE CHARACTERIZATION

Baseline characterization data for each supplemental characterization site were obtained from existing reports. The field studies associated with this project focused on post-treatment

groundwater quality and mass flux assessment from completed thermal remediation sites, and therefore, baseline pre-treatment data had to be obtained from site reports.

5.3 TREATABILITY OR LABORATORY STUDY RESULTS

No treatability or laboratory studies were conducted as part of this project as the focus was on critical assessment of thermal technologies already being applied at the pilot- and full-scale.

5.4 DESIGN AND LAYOUT OF TECHNOLOGY COMPONENTS

No system design was conducted in this project as the focus was on critical assessment of thermal technologies being applied at the pilot- and full-scale. The designs of the thermal remediation systems implemented at sites selected for the supplemental post-treatment assessment work are summarized along with all other thermal system designs reviewed in this work in the tables presented in Chapter 6.

5.5 FIELD TESTING

Field testing for this project differed from other ESTCP projects since no demonstration was performed. Field investigations at four of five demonstration sites focused on the assessment of post-treatment groundwater quality and mass flux of contaminant from the treatment zone. Field investigations at these sites included groundwater sampling for analysis of general water quality parameters and hydrocarbon concentrations, aquifer characterization, soil core collection for verification of geology, and depth to water measurements for groundwater flow direction and gradient. Field investigations at the fifth site focused on groundwater quality response during and following an active thermal treatment.

5.6 SAMPLING AND ANALYTICAL METHODS

To accomplish the goals described above, the following field activities were undertaken:

- A sampling transect down-gradient of the treatment zone and perpendicular to the
 direction of groundwater flow was identified. Each transect encompassed the width of
 the original source zone and down-gradient dissolved plume, unless portions were
 inaccessible. Ideally, transects would have at least 10 sampling locations, each of which
 would have at least five sampling depths. Actual sampling locations and depths were
 dictated by site-specific factors/costs,
- At each sampling location, depth-discrete groundwater samples and aquifer characterization data were collected using direct push technology.
- Groundwater sampling and aquifer characterization was also performed at select monitoring wells in and adjacent to the treatment zone.
- Water samples were analyzed onsite for general chemistry (pH, electrical conductivity, temperature, dissolved oxygen, and oxidation reduction potential) and hydrocarbon concentrations (chlorinated solvent or petroleum hydrocarbon). Hydrocarbon concentrations were analyzed using gas chromatography and were performed on-site to

help guide selection of the sampling locations and provide a basis for any in-the-field revisions to the sampling plan.

Aquifer characterization involved the following activities:

- Aquifer specific-capacity tests: Aquifer specific capacity tests were conducted in permanent monitoring well locations of interest when slug testing was not possible and at all depth-discrete groundwater sample locations where depth to water did not exceed the capabilities of a peristaltic pump. Depth-discrete tests were conducted using a direct-push rod equipped with a groundwater sampler. Specific capacity tests involved the measurement of the steady flow rate achieved with a fixed drawdown; ideally, all tests were conducted with the same fixed drawdown (usually 0.3 1.0 feet), but that was variable depending on the rate of groundwater production at each interval.
- Slug testing: Slug tests were conducted in selected monitoring wells within and directly adjacent to the treatment zone. At one site where depths-to-water were too great (Air Force Plant 4), pneumatic slug testing was used at all depth-discrete groundwater sampling locations.
- Depth-to-water measurements: Depth-to-water was measured in all monitoring wells in and adjacent to the treatment zone. Using survey data from site records, measurements were converted water level elevations to determine groundwater flow direction and gradient at the time of sampling.
- Soil core collection: One to three direct-push soil cores were collected from each site. Continuous soil cores were collected along the downgradient edge of the treatment zone and extended from about 2 ft above the current groundwater elevation down to the deepest known depth of groundwater impact. Soil cores were used to confirm the site geologic conceptual model and, as needed, were subdivided in the lab into sections with visually distinct geologies for permeameter testing.

Sampling and analytical methods are summarized in Table 4.

Depth-discrete groundwater samples were collected using direct-push groundwater samplers (e.g. Geoprobe screen point sampler or groundwater profiler) and peristaltic pumps with dedicated polyethylene tubing. As possible, each sample depth was purged for at least one probe rod volume (typically about 1-L) and until a portable YSI DO meter inserted in a flow-through cell indicated stable DO and temperature readings. When purging was complete, zero-headspace groundwater samples were collected in two 40 ml volatile organic analysis (VOA) vials for analysis on site.

Groundwater sample collection from permanent monitoring wells and/or piezometers was facilitated by peristaltic pump, disposable bailers, or submersible electric pump.

Table 4. Sampling Methods.

Measurement	Description of Analyses						
Field water quality measurements	Analysis of pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP) using an Horiba U-22 with flow through cell. In certain circumstances, only dissolved oxygen was measured using a YSI 550A DO meter with flow through cell. Meters were calibrated as per manufacturer instructions at least once per day.						
Hydrocarbons Chemicals of interest in groundwater (inclusive of Ft. Lewis EGDY samples)	Sample collection: Samples were collected with zero-headspace in 40 mL VOA vials and placed on ice until analyzed. Sample analysis: Heated headspace method with on-column injection. 30-ml sample warmed in 40-ml VOA vial to 35°C followed by 0.5 ml on-column injection of headspace on the GC. Separation by capillary column and analysis by PID, FID, and/or DELCD.						
Specific Capacity	Specific capacity tests were conducted using an electronic water level indicator, a volumetric cylinder, a peristaltic pump, and a stop watch. After driving a direct-push rod to the desired depth, the water level was measured in the rod until stable. Then the polyethylene tubing inlet was lowered 1 ft below the stable water level and the peristaltic pump was run at a high speed that draws the water down to that level (this is apparent by slugs of air coming up in the tubing). At this point, the flow was measured by recording the time to collect 1-L of water, or under low flow conditions, how much water was collected in a ten-minute interval. Successive analyses were conducted to ensure that the yield had reached a stable value.						
Slug Tests	Slug tests were conducted in conventional wells using a data-logging pressure transducer and a slug capable of displacing about 2 ft of water. The slug was either lowered into, or pulled out of the well, and the water level response was monitored until it stabilized at the pre-test level. The data was then analyzed by standard slug-test analysis methods.						

At the time of sample collection, sample vials were labeled with the location ID and sampling depth. Sample collection followed procedures defined in Table 5. Since samples collected at the four field sites were analyzed within 24 hours of collection (and typically within 4 hours), samples were only preserved on ice. Since Ft. Lewis EGDY samples were shipped, they included hydrochloric acid (HCl) preserve.

Table 5. Groundwater Sample Collection Procedures.

Matrix	Analyte	Container	Preservative	Holding Time
	Chlorinated and	40 ml VOA	Ice*	<24 hours (on site)
Groundwater	Petroleum Hydrocarbons	40 ml VOA	HCl, Ice (Fort Lewis EGDY site only)	<7 days (shipped to ASU)

All hydrocarbon analyses including the Ft. Lewis EGDY analyses were conducted using a heated headspace (35°C) method on dedicated SRI Model 8610C gas chromatographs equipped with FID, PID, and DELCD detectors and a DB-1 type capillary column. The instruments were calibrated each day against at least three different concentrations spanning the concentration range of interest (e.g. 10, 100, 1000 μ g/L for dissolved concentrations). In addition, calibration samples were analyzed on a regular basis throughout each day to detect instrument drift. Reporting levels of 1 μ g/L were established based on the calibration results.

Quality assurance (QA) samples were collected at a frequency of not less than one in ten samples. QA samples included both duplicate (split) sample collection and analysis and replicate sample analysis.

All sampling locations were recorded. For temporary sampling or transect locations, exact location was based on measurement from at least two known surveyed locations (i.e., existing wells). These measurements were then used for plotting purposes and northings/eastings could be back-calculated from known survey points. Sample locations for Ft. Lewis EGDY were surveyed.

All sampling activities were recorded in site dedicated field books. More specifically, all project, field personal maintained a continuous record of site activities their own dedicated field book.

Appendix E provides additional detail on the calibration of analytical equipment, quality assurance sampling, decontamination procedures, and sample documentation.

5.7 SAMPLING RESULTS

Specifics of the supplemental site investigation are summarized below. More detailed individual field summary reports are provided in Appendix D. Table 6 summarizes details of the sampling transects (transect length, number of sampling locations, depth intervals, etc.). Table 7 provides the number of locations where groundwater samples were collected and aquifer characterization tests were performed. Tables 8 and 9 provide an overview of pre- and post-treatment groundwater concentrations and calculated mass discharge for each site, respectively. Table 9 also provides the calculated mass discharge normalized to the width of the treatment zone perpendicular to the flow direction [mass discharge per linear distance]. The mass discharge calculations were performed using the ESTCP-sponsored Mass Flux Toolkit software provided by GSI, Inc. Mass discharge calculations for each of the constituents can be found in the field reports in Appendix D.

Table 6. Mass Discharge Sampling Transect Details for Supplemental Site Investigations.

Site ID	Number of Transect Sampling Locations	Transect Length (ft)	Vertical Sampling Interval (ft bgs)	Number of Depth- Specific GW Samples	Number of Aquifer Specific- Capacity Tests
Hunter Army Airfield Former Pumphouse #2	10	400	12 - 22	48	47
Air Force Plant 4 Bldg 181	10	170	29 - 35	13	9
NAS Alameda Site 5-1, Bldg. 5	7	115	6.5 - 21	39	39
Camp LeJeune Site 89	7	255	3 - 40	78	62
Ft. Lewis EGDY Area 3*	N/A	N/A	N/A	N/A	N/A

ft - Feet

Note: All analysis were performed via groundwater samples from permanent monitoring wells collected by the Corp of Engineers and were sent directly to ASU for analysis. Analyses were performed pre-, during, and post-treatment to gauge how contaminant flux changed while treatment was occurring.

Table 7. Total Number and Types of Samples Collected.¹

Site	Sampling Location	Number of GW Sample Locations	Number of Aquifer Characterization Test Locations	Analytes	
Hunter Army	Permanent Monitoring Wells	12	11	Petroleum	
Airfield, Former Pumphouse 2	Transect/Discrete-depth Locations	Transect/Discrete-depth Locations 10 48		Hydrocarbons	
Air Force Plant 4	Permanent Monitoring Wells	18	15	Chlorinated	
Bldg. 181	Transect/Discrete-depth Locations	11	13	Solvents	
NAS Alameda	Permanent Monitoring Wells	11	11	Chlorinated	
Site 5-1,Bldg. 5	Transect/Discrete-depth Locations	7	39	Solvents	
Camp LeJeune	Permanent Monitoring Wells	26	23	Chlorinated	
Site 89	Transect/Discrete-depth Locations	7	78	Solvents	
Ft. Lewis EGDY Area 3	Permanent Monitoring Wells	17 (16 sampling events)	0* (16 sampling events)	Chlorinated Solvents	

¹ Exact information on total number of samples collected can be found in Appendix D which contains the Field Reports for each site.

bgs - Below ground surface

N/A - Not applicable to this site -

^{*} Aquifer characterization data for the wells used were obtained from site reports for the Fort Lewis EGDY site.

 $\begin{tabular}{ll} \textbf{Table 8. Range of Permanent Monitoring Well Pre- and Post-Treatment Concentration Data~(ug/L).} \end{tabular}$

Site	Contaminant	Pre-treatment Concentration Ranges From Site Documentation (ug/L)		Post-treatment Concentration Ranges from Supplemental Field Investigations Performed Under This Study (ug/L)	
		High	Low	High	Low
Hunter Army Airfield, Former Pumphouse 2	Benzene	1,670	102	342	ND<1
	Toluene	3,630	7.6	18	ND<1
	Ethylbenzene	9,470	426	377	ND<1
	Xylenes	40,500	594	169	ND<1
	Naphthalene	N/A	N/A	43	ND<1
	Vinyl Chloride	N/A	N/A	1	ND<1
	1,1-Dichloroethene	N/A	N/A	120	ND<1
	Trans-1,2-Dichloroethene	N/A	N/A	26	ND<1
	1,1-Dichloroethane	N/A	N/A	390	ND<1
Air Force	Cis-1,2-Dichloroethene	N/A	N/A	14,000	ND<1
Plant 4, Bldg 181	1,2-Dichloroethane	N/A	N/A	670	ND<1
Diug 161	1,1,1-Trichloroethane	N/A	N/A	1	ND<1
	Trichloroethylene	285,000	5,960	59,000	130
	1,1,2-Trichloroethane	N/A	N/A	ND<1	ND<1
	Tetrachloroethene	N/A	N/A	5	ND<1
	Vinyl Chloride	8,140	ND<0.5	29	ND<1
	1,1-Dichloroethene	15,100	ND<0.5	2	ND<1
	Trans-1,2-Dichloroethene	300	ND<0.5	2	ND<1
NIAC AL L	1,1-Dichloroethane	48,800	15	2	ND<1
NAS Alameda,	Cis-1,2-Dichloroethene	13,700	ND<1.3	71	ND<1
Site 5-1,	1,2-Dichloroethane	ND<250	ND<0.5	ND<1	ND<1
Bldg. 5	1,1,1-Trichloroethane	42,000	ND<0.5	ND<1	ND<1
	Trichloroethylene	1,600	ND<0.5	76	1
	1,1,2-Trichloroethane	ND<250	ND<0.5	ND<1	ND<1
	Tetrachloroethene	54	ND<0.5	47	ND<1
	Vinyl Chloride	1,400	ND<1	24,000	ND<1
	1,1-Dichloroethene	N/A	N/A	1,700	ND<1
	Trans-1,2-Dichloroethene	49,800	ND<2	33,000	ND<1
Camp LeJeune, Site 89	Cis-1,2-Dichloroethene	224,000	ND<2	110,000	1
	Trichloroethylene	541,000	ND<2	140,000	ND<1
	1,1,2-Trichloroethane	18,600	ND<2	3,600	ND<1
	Tetrachloroethene	3,720	ND<2	1,800	ND<1
	1,1,2,2-Tertrachloroethane	2,240,000	ND<2	240,000	ND<1
	Vinyl Chloride	5,800	ND<1	170	ND<1
	1,1-Dichloroethene	N/A	N/A	24	ND<1
E. I.	Trans-1,2-Dichloroethene	480	ND<1	38	ND<1
Ft. Lewis EGDY Area 3	Cis-1,2-Dichloroethene	30,000	ND<1	2,200	ND<1
	Trichloroethylene	17,000	2	2,200	ND<1
	Tetrachloroethene	9	ND<1	1	ND<1
	1,3,5-Trimethylbenzene	88	ND<1	19	ND<1
	1,2,4-Trimethylbenzene	22	ND<1	ND<1	ND<1

Note: * NAPL was found in a well; ND<X denotes non-detection at X ug/L detection level

Table 9. Summary of Mass Discharge (Mass Flux) Calculations at Field Investigation Sites.

Site	Contaminant	Pre-treatment Discharge (kg/yr) ¹	Post-treatment Mass Discharge (kg/yr) ²	Post-treatment Mass Discharge per Linear Foot (kg/yr/ft)
Hunter Army Airfield Former Pumphouse 2*		5.2 x 10 ¹	1.9 x 10 ⁻¹	1.1 x 10 ⁻³
Air Force Plant 4 Bldg 181**	Total	6.0 x 10 ¹	2.1×10^{1} 4.9	1.4 x 10 ⁻¹ 3.4 x 10 ⁻²
NAS Alameda Site 5-1, Bldg. 5*	Contaminant Flux	4.9 x 10 ¹	1.3 x 10 ⁻¹	9.6 x 10 ⁻⁴
Camp LeJeune Site 89*	Tiux	6.8×10^2	8.2 x 10 ¹	5.5 x 10 ⁻¹
Ft. Lewis EGDY Area 3***		3.2 x 10 ¹	2.1	1.9 x 10 ⁻²

¹ Mass discharge calculations were based on monitoring well data from the documentation.
2 Mass discharge calculations were based on discrete-depth sampling data, or a combination of discrete-depth sampling data and monitoring well

^{*} Mass discharge calculations were base on discrete-depth sampling data only.

^{**} Mass discharge calculations were performed for discrete-depth sampling data only and discrete-depth sampling data with monitoring well

^{***} Mass discharge calculations were based on monitoring well data analyzed by ASU personnel.

6.0 PERFORMANCE ASSESSMENT

The performance objectives of this demonstration included:

- Collecting application data (design, setting, operating conditions, performance) from in situ thermal applications and then compile and synthesize that information in a way that would assist others to anticipate the applicability and performance of in situ thermal technologies at their sites.
- Assess changes in groundwater quality and contaminant mass discharge from source zones treated with in situ thermal technologies.

The results from each are discussed below. Section 6.1 focuses on the former, while Section 6.2 focuses on the latter.

6.1 EMPIRICAL DATA COLLECTION AND SYNTHESIS WITH EMPHASIS ON SETTING, DESIGN, AND OPERATING CONDITIONS

The in situ thermal treatment application data collected in this study were obtained from a variety of sources including: (1) site reports, (2) published literature, (3) Environmental Protection Agency (EPA) cost and performance reports, (4) discussions with project managers, vendors, and consultants, and (5) unpublished data and observations. Sites for which data were collected encompassed in situ thermal technology applications world-wide and included electrical resistance heating (ERH), steam-based heating with and without hot water injection, conductive heating, and other methods (radio-frequency heating (RFH), hot air injection, and in situ soil large diameter auger mixing with steam and/or hot air injection).

For each technology application studied, emphasis was placed on identifying:

- the setting (geology, depth to groundwater, source zone boundaries, chemicals present, etc.),
- system design parameters (number of energy delivery points, area and depth of the treatment zone, etc.),
- operating conditions (temperature achieved, duration of treatment, duration of monitoring, etc.), and,
- performance data (emphasizing improvement in groundwater quality and reduction in mass discharge of contaminant to the aquifer).

Capture of this data involved data interpretation and the use of professional judgment, especially when comparing pre- and post-treatment groundwater impacts. To simplify data reduction and remain consistent with the typical quality and quantity of available data, performance was quantified only in terms of order-of-magnitude reductions in groundwater concentrations and source zone mass discharges.

Each technology application reviewed was assigned to one of five idealized geologic scenarios, much in the same way that the NRC (2004) used generic conceptual models to summarize knowledge about treatment technologies in general. The idealized scenarios were as follows:

- *Scenario A*: relatively homogeneous and permeable unconsolidated sediments (mixtures of sands, gravels, silts, etc.)
- *Scenario B*: largely impermeable sediments with inter-bedded layers of higher permeability sediments
- *Scenario C*: largely permeable sediments with inter-bedded lenses of low permeability sediments
- *Scenario D*: competent, but fractured bedrock (i.e. crystalline rock)
- *Scenario E*: weathered bedrock (limestone, sandstone, etc.)

A category for homogeneous and impermeable settings was not created, as this setting rarely occurs and most low permeability sites have layers, albeit thin, of higher conductivity materials (Scenario B). A generic diagram of each geologic setting can be found in Figure 4.

Finally, the results were compiled and synthesized in tables in a manner thought to be useful to practitioners interested in evaluating thermal treatment options for their sites. The structure of these tables is discussed in more detail below.

After a rigorous review of the data, compiled information was sent to each respective site contact for their review and to see if additional information could be obtained.

A total of 182 in situ thermal treatment technology applications at 163 different sites were identified in this study. Table 10 presents the number of in-situ thermal applications by technology. It also indicates how many were full-scale vs. pilot-scale applications and how many occurred since 2000. As can be seen, about half of all applications (98 of 182) were implemented at full-scale, with roughly half of those (56 of the 98) being ERH systems. Table 10 also shows that 84 of 182 applications (46%) have been implemented since 2000, over half (57%) of which were ERH systems. ERH applications outnumber all other applications since 2000 by about a factor of three, and there also seems to be a recent trend in the increasing use of conductive heating and decreasing use of steam heating.

Since the quantity and quality of information available for each application varied, a scale of 0 to 4 was used to characterize data availability for each site. Table 11 defines this scale and also summarizes the number of applications falling into each category. The following are of note:

- Sufficient data were available to identify the target chemicals of concern at 159 of 182 sites (87%).
- Sufficient data were available to identify the treatment area for 62 of 182 sites (34%) and the density of energy delivery points at 57 of 182 sites (31%); these are basic system design parameters that were compiled in this study.

- Sufficient data were available to identify the peak temperature at 49 of 182 sites (27%) and the duration of heating at 59 of 182 sites (32%); these are basic operational parameters that were compiled in this study.
- Post-treatment groundwater monitoring data were available for only 14 of 182 sites (8%); these are the basic performance data that were compiled in this study.

Thus, while there have been a large number of thermal treatment applications (at least 182), data collected for this project indicated that many have been poorly documented. This study, therefore, can provide insight to the range of settings to which thermal technologies have been applied, the designs that have been applied, and the operating conditions. However, it cannot provide much information on the actual performance of these technologies since the long-term effect on groundwater quality improvements and source zone discharge reductions appear to be poorly documented and/or not monitored at many thermal treatment sites.

Table 10. Summary of Technology Applications by Technology Type.

Technology	Number of Applications	Pilot-Scale*	Full-Scale*	Number Since Year 2000
Steam-Based Heating	46	26	19	15
Electrical Resistance Heating	87	23	56	48
Conductive Heating	26	12	14	17
Other (including Mixing/Heating)	23	14	9	4
Total	182	75	98	84

^{*} Some sites have an unknown application size and thus are not included in the Pilot- and Full-scale count.

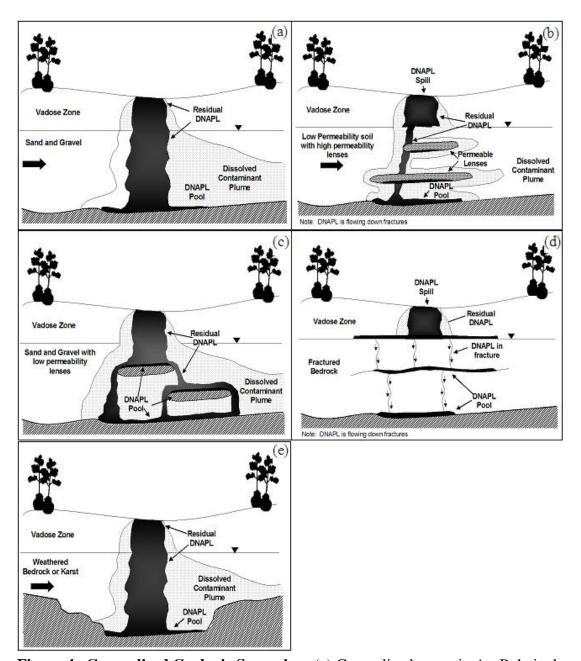


Figure 4. Generalized Geologic Scenarios. (a) Generalized scenario A - Relatively homogeneous and permeable unconsolidated sediments (mixtures of sands, gravels and silts, etc.); (b) Generalized scenario B - Largely impermeable sediments with inter-bedded lenses of higher permeability material; (c) Generalized scenario C - Largely permeable sediments with inter-bedded lenses of low permeability material; (d) Generalized scenario D - Competent, but fractured bedrock; (e) Generalized scenario E – Weathered bedrock.

Table 12 summarizes the aggregate design information for all applications reviewed. As can be seen, 117 of 121 applications for which data were available involved treating areas $<4 \times 10^4 \text{ ft}^2$ ($<3716 \text{ m}^2$, or about one acre) and roughly two-thirds of those involved treatment zones smaller than 10^4 ft^2 ($<929 \text{ m}^2$, or about a quarter-acre). Table 12 also indicates that the distribution was similar for all of the technologies.

Table 11. Characterization of the Data Available from the 182 Applications Reviewed.

Level of Data Quantity	Description	Number of Sites
-	Application in progress	1
0	No documentation available at the time of this study	26
1	Insufficient data to assess performance of technology, but some design information	78
2	Limited performance data; some soils and/or groundwater concentration data and some operating data (e.g., temperature information)	37
3	Good performance data record, but insufficient for estimating differences between pre- and post mass discharge from source zone	26
4	Data sufficient for full assessment of performance (groundwater concentrations and mass discharge)	14
	Total	182

Table 12. Basic Design Information Compiled for all Sites Reviewed.

Technology		ber of Sites Wi nes With Sizes			Number of Sites With Density of Energy Delivery Points (electrodes or wells) In this Range [# per 100 ft²]							
	<104	$10^4 - 4x10^4$	<4x10 ⁴	Unknown	<0.25	0.25-0.50	>0.5	Unknown				
Steam-Based Heating	16	6	4	20	20	2	4	20				
Resistance Heating	36	24	0	27	10	23	27	27				
Conductive Heating	19	6	0	1	1	1	23	1				
Other(including Mixing/Heating)	8	2	0	13	2	0	8	13				

^{*} For the three steam auger sites, the density is one energy point per cell. This does not fit into the number calculation so it is classified as <0.5.

With respect to the area density of energy delivery points (i.e., steam injection wells, electrodes, and in situ heaters), there were clear differences between the technologies. Table 12 categorizes the number of energy delivery points per 100 ft²(~ per 10 m²), and indicates that most steam-based heating designs (20 of 26 with sufficient information) had densities of less than one energy delivery point per 400 ft² (~ one per 40 m², or greater than 20-ft (6-m) spacings), while most conductive heating applications involved densities greater than one energy delivery point per 200 ft² (~ one per 20 m², or less than 14 ft (4.2 m) spacings). Electrical resistance heating applications spanned the range of density categories, but were weighted more towards higher densities and electrode spacings less than 20 ft (6 m).

Table 13 summarizes the basic operating conditions for all of the applications reviewed. Of the 95 applications for which temperature data were available, 63 were operated at temperatures in the 80-110°C range in the target treatment zone. With respect to technology, most (37 of 46, or 80%) of the electrical resistance heating applications were operated within that 80-110°C range, while one-third (7 of 21) of the steam-based heating applications were operated at temperatures less than 80°C and about half of the conductive heating applications were operated at temperatures greater than 110°C.

Of note in Table 13 are the durations of application. For the applications for which data were available, 81 of 84 were operated for less than six months, and this pattern is true for all thermal technologies. It should be noted that there was little documentation as to the criteria or rationale used to determine the duration of operation; in many cases, it appeared that the duration was determined prior to start-up or may have been linked to some time-temperature criterion (i.e., operate for 2 months once a target temperature is reached). There was little indication that the duration of operation was linked to mass removal-, groundwater quality-, or soil concentration-based criteria.

Table 13. Basic Operating Conditions Summary for all Applications Reviewed.

Technology	T Ta	emperarget T e in Th	Sites Vatures i reatme lese Ra	in ent	A	ber of active l rations Rang	Heatin s in Th	ıg	Number of Sites With Post-Treatment Monitoring in These Ranges [y]					
	08>	011 - 08	>110	Unknown	<0.5	0.5 - 1.0	>1.0	Unknown	5.0>	0.5 - 2.0	>2.0	Unknown		
Steam-Based Heating	7	13	1	25	14	0	3	29	2	0	0	44		
Resistance Heating	9	37	0	41	38	2	0	47	1	5	1	80		
Conductive Heating	0	11*	12*	4	18	3	0	5	1	1	0	24		
Other (including Mixing/Heating)	2	2	1	18	6	0	0	17	3	0	0	20		

^{*} One site had two different temperature values. The 80-110 C temperature was for the saturated zone and the >110 C temperature for the vadose zone.

One might argue that applications conducted in recent years are more representative of the current state-of-the practice. For that reason, the Overall Data Summary Table (Table 14) was prepared using only data from the 84 applications conducted since 2000 that were reviewed in this study. This table was formatted to flow from left to right, beginning with the five "generalized conceptual scenarios". The thought behind its structure was that practitioners interested in assessing the potential applicability of thermal technologies to their site would first choose the generalized conceptual scenario that best matches their site conditions. Then, by viewing from left to right across the table, they would be able to quickly review the experience base for each technology as applied to that generalized conceptual scenario.

The major columns found to the right of the generalized conceptual scenarios and each thermal technology include the total number and types of applications (pilot- vs. full-scale), chemicals treated, basic design parameters, basic operating parameters, and performance measures. Columns found under each of these main headings represent categories (i.e., pilot-scale vs. full-scale under "# of sites" heading) or distributions of specific numerical values as in the case of the "Design Parameters" heading (e.g., three options for temperature in the treatment zone are presented: $<80^{\circ}$ C, $80-110^{\circ}$ C, and $>110^{\circ}$ C). The numerical entry in each box of this table represents the number of sites matching that combination of conditions caused by the intersection of the row and column. For example, there are four applications of resistance heating in generalized conceptual scenario C with treatment areas $<10^4$ ft² (~ 1000 m² or one-quarter acre). Note that the number of applications totaled in each column may not total 84 due to the fact that the information might not be available for all 84 applications. In general, there is a trend towards having less information as one moves through the columns from left to right across Table 14.

Table 14 shows that majority of the thermal applications were conducted in generalized scenarios B and C. Scenario B (low permeability with high permeability lenses) accounts for 43% (36 of 84) of thermal treatments, two-thirds of which are ERH applications. Of interest was that most conductive applications occur in scenario B (10 of 17), as do ERH applications (24 of 48). Scenario C (high permeability with low permeability lenses) settings account for roughly another one-third (29%) of all applications. The majority of applications in scenario C settings are ERH, although steam-heating had most of its applications (6 of 15, or 40%) within this geologic setting.

Few applications in generalized scenarios A, D, and E were identified in this study (7, 4, and 1 of 84 total documented applications, respectively). This may reflect the low frequency of occurrence of homogeneous settings in nature (scenario A) as well as the difficulty and risks in dealing with complex fractured and bedrock settings.

Table 14 also summarizes information available on the chemicals present at 83 of 84 sites. Of those 83 sites, chlorinated solvents were treated at 63 (75%) of the sites. Petroleum hydrocarbons were the other main contaminant category treated by thermal applications and represent about 36% (30 of 84) of sites in this study. Wood-treating and other chemicals accounted for about 13% of sites (11 of 84).

Table 14. Summary of Key Information Gathered from Reviewed Applications Conducted Since 2000.

Part					tal tes	Cher	nical(s) T	reated	ı	Desi	ign Paı					O		ng Para							Pe	rform	ance N						
SATE 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2	Gen	neralized Conceptual Scenario	Technology		Б	# of Sites Treating	rnese Chemicals (C- chlorinated solvents, P-petroleum hydrocarbons, W-	wood treating, O- other)	# of Sites With	Target Treatment Zones With Sizes In	This Range [ft²]	# of Sites With Density of Energy	Delivery Points (electrodes or wells) In this Range [# per 100 ft?]	# of Sites With	Temperatures in Target Treatment	Zone in These Ranges [C]		# of Sites with Active Heating Durations in These Ranges [y]		# of Sites With Post-	in These Ranges [y]	Sites With Final	Dissolved Concentrations Generally In This	Range [ug/L]	Sites With	Reduction In This		Sites With Final Mass Discharges Generally	In This Range [kg/y]		Sites With Mass Discharge Reduction	In This Kange [%]	
Methodology of the control of the co				Pilot Tests	Full-Scale				<104	10 ⁴ - 4x10 ⁴			50		80 - 110	>110		1.0				<10		100 - 1000	10X	100X	1000X	0 - 10	×10	10X	100X	1000X	
Methodology of the control of the co		華 華	SEE	1	0	0	1 0	0	1	0	0	1	0 0	0	0	0	0	1	0) (0	0	0	1	1	0	0 0) 0	0	0	0	0	Guadalupe
1510 1. 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2	relatively homogeneous and		ERH	0	1	0	1 0	1	1	1	0	0	1 1	0	3	0	1	0	0 () () 1	0	0	1	1	0	0 1	0	0	0	1	0	Hunter Army Airfield
Seminal Lines Seminal Control Lines Seminal	unconsolidated sediments (mixtures of sands, gravels	Dissolved Contaminant	ISTD	1	4	4	3 0	1	2	1	0	0	0 3	0	2	2	1	2	0 (0 1	0	0	0	1	0	0	1 0	0	0	0	0	0	
Semental Burget promote Burget promote	and silts, etc.)		Other	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0) (0	0	0	0	0	0	0 0	0	0	0	0	0	
Sementical surgests of the control o	Generalized	* *	SEE	1	1	2	0 0	0	1	0	0	1	0 0	0	1	0	1	0	1	1 (0	0	1	0	1	0	0 0	0	0	0	0	0	
Generalized Scenario C. Israely Scenario C. Is	impermeable sediments with	Vadote Zone Residual CNAP.	ERH	6	18	16	9 1	1	14	7	0	3	8 9	3	10	0	11	7	2	1 (0	1	1	5	2	2	3 0	0	1	1	0	0	Air Force Plant 4
See	of higher permeable	Parmedite Larnes Dissolved Contaminant Plants	ISTD	3	7	7	1 2	2	7	3	0	0	1 9	0	7	2	1	5	2 () (0	2	0	2	0 0	0	0	0	0	0	Alhambra Pole Yard
Seemards: Largely permetable and recommendation of the permetable and recommendation		Note: (DAP), is Storing ton-Pathong	Other	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0	0 (0	0	0	0	0	0	0 0	0	0	0	0	0	
permeable services of the permeable services of the permeable services of the permeable material substitute of the permeable materials. ISTD O O O O O O O O O		*		 				1			1	•		+						+	+	1		-	•	0			+				National Laboratory NAS Alameda Site 5-1 ERH,
Other 1 2 3 3 3 0 0 1 1 2 0 0 0 1 1 2 0 0 0 1 1 2 0 0 0 1 1 2 0 0 0 0	permeable sediments with interbedded lenses	Residuel ONAPL ▼						+	H			•		+						+	+										1		
SEE 2 1 3 1 0 0 0 2 0 0 1 0 1 1 0 0 1 1 1 0 0 0 0				1				+	1					+					-	+	+	1				+	+			+			
Generalized Scenario D: Competent, but fractured bedrock Generalized Scenario E: weathered bedrock ISTD O O O O O O O O O O O O O O O O O O O		4 4	SEE	2	1	3	1 0	0	2	0	0	1	0 1	1	1	0	3	0	0	1 (0 0	0	0	2	2	0	0 1	0	0	1		0	Edwards Air Force Base,
Scenario D: competent, but fractured bedrock ISTD O O O O O O O O O							0 0	0	0		0	0	0 0	0	0	0	0	0	0 () (0			+) 0	0	0	0	0	Loring Air Force Base
SEE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	competent, but		ISTD	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 () (0	0	0	0	0	0	0 0	0	0	0	0	0	
Generalized Scenario E: Weathered bedrock SEE 1 2 2 1 1 0 0 0 0 0 0 0 0		DNAPA Proof	Other	0	1	1	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0 () (0	0	0	0	0	0	0 0) 0	0	0	0	0	
Generalized Scenario E: Weathered bedrock SEE 1 2 2 1 1 0 0 0 0 0 0 0 0			SEE	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0) (0	0	0	0	0	0	0 0	0	0	0	0	0	
Weathered bedrock STD 1	Scenario E:		ERH	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0) (0	0	0	0	0	0	0 0	0	0	0	0	0	
SEE 1 2 2 1 1 0 0 0 0 1 3 0 1 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Plane	ISTD	1	0	1	1 0	0	1	0	0	0	0 1	0	1	0	1	0	0		0	0	0	0	0	0	0 0	0	0	0	0	0	
ERH 4 4 7 2 0 0 1 3 0 1 2 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																																	
				_				_	_	_		_		_	_											_		_	_	_	_		
Other 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Unknown Scenario		ISTD	1	0	0	0 0	0	1	0	0	0	1 0	0	0	0	0	0	0 () () 0	0	0	0	0	0	0 0) 0	0	0	0	0	

Notes:

84 sites with systems have been installed since 2000, but only 72 of these sites have known geologic settings.

Data may total more than the total number of sites because some sites treated more than one type of contaminant during an application

SEE – Steam Enhanced Extraction (Steam-based Heating)

ERH - Electrical Resistance Heating

ISTD – In Situ Thermal Desorption (Conductive Heating)

Other – Other Heating Methods (i.e. Radio-Frequency Heating or In Situ Soil Mixing combined with Heating) Design and operating parameter information is discussed above for all sites and the data in Table 14 reflect that discussion. Of note is the absence of information for applications conducted in generalized scenarios D and E except for steam heating in scenario D.

This study collected and documented a large amount of information on thermal applications, which has been summarized above in Table 14. An additional summary table, Site-Specific Summary Table (Plate 1 – see electronic attachment *Site Specific Summary Table*) contains detailed site-specific information for all thermal applications identified in this study.

6.2 EMPIRICAL DATA COLLECTION AND SYNTHESIS WITH EMPHASIS ON PERFORMANCE (GROUNDWATER QUALITY AND MASS DISCHARGE CHANGES)

As discussed above, there was sufficient documentation to assess changes in groundwater quality and source zone mass discharge for only 14 of the 182 applications identified in this study. Two of the 14 were described as pilot treatments; however, the treatment zone appeared to completely encompass the source zone at those sites so a mass discharge analysis was performed. Table 15 presents the estimated order-of-magnitude concentration and mass discharge percent reductions for those 14 sites and reflects data from site reports and from the supplemental post-treatment assessment field work conducted during this project. In 9 of 14 sites (64%), the dissolved groundwater concentration reduction was about one order-of-magnitude (10X) or less and four sites had concentration reductions equal to or greater than two orders-of-magnitude (100X). Because mass flux or discharge calculations involve spatially variable hydraulic conductivity data, the mass discharge reduction can differ from the overall concentration reduction. For example, at sites with a 10X concentration reduction or less, the estimated mass discharge reduction varied from <10X to 1000X. Nine sites had mass discharge reductions of about 10X or less and almost one-half of the sites (6 of 14, or 43%) had at least a 100X reduction in mass discharge (please note that Site #6 is counted in both the less than or equal to 10X reduction and greater than or equal to 100X because the mass discharge values were calculated for two different vertical intervals).

Table 15. Summary of Source Zone Dissolved Groundwater Concentration and Mass Discharge Reductions Achieved at Sites with Sufficient Data to Perform this Analysis

			Dissolved	N	Iass D	ischarg	e Reduct	tion
Site No.	Heating Technology	Generalized Scenario/Site	Groundwater Concentration Reduction	<10x	10x	100x	1000x	>1000x
1	ERH	Generalized Scenario A (SDC)	10x			X		
2	ERH	Generalized Scenario B ^{+ (SDC)}	<10x	X	X			
3	ERH	Generalized Scenario C	10x		X			
4	ERH	Generalized Scenario C* (SDC)	>10x to $<100x$		X			
5	ERH	Generalized Scenario C [^]	<10x	X				
6	ERH	Generalized Scenario C [^]	<10x	X		X		
7	ERH	Generalized Scenario C	<10x				X	
8	ERH	Generalized Scenario C (SDC)	10x		X			
9	ERH	Generalized Scenario C (SDC)	100x			X		
10	ERH	Generalized Scenario C	1000x		X			
11	SEE	Generalized Scenario C	100x			X		
12	SEE	Generalized Scenario C	10x	X				
13	SEE	Generalized Scenario C ^	10000x				X	X
14	SEE	Generalized Scenario D*	<10x	X	·			

^{*} Pilot application appeared to encompass the entire source zone based on documentation reviewed.

Table 16 provides the calculated mass discharge rates for the sites summarized in Table 15. Again, the table entries reflect data gathered from reports as well as data collected during the supplemental data collection phase of this project.

Mass discharge calculations were performed using the ESTCP-sponsored Mass Flux Toolkit software by GSI, Inc. In addition to the mass flux calculation, this software allows for an uncertainty analysis of calculations and presents a statistical breakdown of the contribution each sampling location makes to the total mass discharge. An uncertainty analysis was performed for the main contaminant of concern at each field site.

Uncertainty analyses for each site indicated that most locations contributed fairly equally to the total mass discharged. However, at each site there were one or two locations where groundwater concentrations and/or hydraulic conductivity resulted in contributions of greater than +/- 25% to the total mass discharge. Appendix F presents the uncertainty analyses for each of the five field sites.

⁺ Mass discharge assessment involved two calculations using first only the post-treatment field investigation data and then the post-treatment field investigation data supplemented with data from a set of monitoring wells that were directly in line with the field investigation transect.

[^] Site used two different vertical intervals to calculate mass discharge: 1) Only shallow geology and 2) shallow and deep geology.

SDC – supplemental data collection site for this project

Table 16. Summary of Mass Discharge Estimates for Sites with Sufficient Data

$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Site No.	Heating Technology	Site	Contaminant	Pre- treatment Discharge (kg/yr) ¹	Post- treatment Discharge (kg/yr) ²	Post- treatment Discharge per Linear Foot (kg/yr/ft)
Serial Generalized Scenario B** Serial Serial Generalized Scenario C	1	ERH	Generalized Scenario A * (SDC)		5.2×10^{1}	1.9 x 10 ⁻¹	1.1 x 10 ⁻³
3 ERH Generalized Scenario C 4.0 x 10 ⁻¹ 3.1 x 10 ⁻² 1.5 x 10 ⁻³ 4 ERH Generalized Scenario C \(^{\lambda}\) 5 ERH Generalized Scenario C \(^{\lambda}\) 6 ERH Generalized Scenario C \(^{\lambda}\) 7 ERH Generalized Scenario C \(^{\lambda}\) 8 ERH Generalized Scenario C \(^{\lambda}\) 9 ERH Generalized Scenario C \(^{\lambda}\) 10 ERH Generalized Scenario C \(^{\lambda}\) 10 ERH Generalized Scenario C \(^{\lambda}\) 10 ERH Generalized Scenario C \(^{\lambda}\) 11 SEE Generalized Scenario C \(^{\lambda}\) 12 SEE Generalized Scenario C \(^{\lambda}\) 13 SEE Generalized Scenario C \(^{\lambda}\) 14 SEE Generalized Scenario C \(^{\lambda}\) 15 SEE Generalized Scenario C \(^{\lambda}\) 16 SEE Generalized Scenario C \(^{\lambda}\) 17 6.0 x 10 ⁻¹ 4.0 x 10 ⁻³ 2.4 9.7 x 10 ⁻¹ 6.5 x 10 ⁻³ 9.4 2.7 x 10 ⁻² 1.4 x 10 ⁻⁴ 4.9 1.6 8.7 x 10 ⁻³ 9.3 1.7 x 10 ⁻² 6.3 x 10 ⁻⁵ 1.9 x 10 ⁻² 1.3 x 10 ⁻¹ 9.6 x 10 ⁻⁴ 1.1 x 10 ⁻¹ 9.6 x 10 ⁻⁴ 1.2 5.4 x 10 ⁻² 1.6 x 10 ⁻⁴ 1.3 2.8 1.0 x 10 ⁻⁵ 1.9 x 10 ⁻² 1.8 x 10 ⁻⁷ 1.2 x 10 ⁻⁹ 2.9 x 10 ⁻⁴ 1.1 x 10 ⁻⁷ 7.1 x 10 ⁻¹⁰	2	EDH	Ganaralized Scanario B** (SDC)		60 v 10 ¹	2.1×10^{1}	
4 ERH Generalized Scenario C * (SDC) 5 ERH Generalized Scenario C ^^ 6 ERH Generalized Scenario C ^^ 7 ERH Generalized Scenario C ^^ 8 ERH Generalized Scenario C *** (SDC) 9 ERH Generalized Scenario C * (SDC) 10 ERH Generalized Scenario C Generalized Scenari	2	EKH	Generalized Scenario B				
5 ERH Generalized Scenario C ^^ Total Contaminant Mass Discharge (sum of all components) Total Contaminant Mass Discharge (sum of all components) 1.7 6.0 x 10 ⁻¹ 4.0 x 10 ⁻³ 4.0	3	ERH			4.0 x 10 ⁻¹	3.1 x 10 ⁻²	1.5×10^{-3}
5 ERH Generalized Scenario C ^^ Total Contaminant Mass Discharge (sum of all components) Total Contaminant Mass Discharge (sum of all components) 1.7 6.0 x 10 ⁻¹ 4.0 x 10 ⁻³ 4.0	4	ERH	Generalized Scenario C * (SDC)		6.8×10^2	8.2×10^{1}	5.5 x 10 ⁻¹
Total Contaminant Mass Discharge (sum of all components) ERH Generalized Scenario C*** (SDC) ERH Generalized Scenario C * (SDC) ERH Generalized Scenario C 11 SEE Generalized Scenario C SEE Generalized Scenario C Generalized Scenario C SEE Generalized Scenario C Generalized Scenario C Generalized Scenario C Total Contaminant Mass Discharge (sum of all components) 9.4 2.7 x 10 ⁻² 1.4 x 10 ⁻⁴ 4.9 1.6 8.7 x 10 ⁻³ 9.3 1.7 x 10 ⁻² 6.3 x 10 ⁻⁵ 7.4 1.6 x 10 ⁻² 6.0 x 10 ⁻⁵ 3.2 x 10 ¹ 2.1 1.9 x 10 ⁻² 4.9 x 10 ¹ 1.3 x 10 ⁻¹ 9.6 x 10 ⁻⁴ 1.2 5.4 x 10 ⁻² 1.6 x 10 ⁻⁴ 1.2 5.4 x 10 ⁻² 1.6 x 10 ⁻⁴ 1.3 2.8 1.0 x 10 ⁻⁵ 1.9 x 10 ⁻² 1.8 x 10 ⁻⁷ 1.2 x 10 ⁻⁹ 2.9 x 10 ⁻⁴ 1.1 x 10 ⁻⁷ 7.1 x 10 ⁻¹⁰	5	EDII			1.7	6.0 x 10 ⁻¹	4.0 x 10 ⁻³
6 ERH Generalized Scenario C^^ Contaminant Mass Mass 4.9 1.6 8.7 x 10^3 1.4 x 10^4 4.9 1.6 8.7 x 10^3 8.7 x 10^3 9.3 1.7 x 10^2 6.3 x 10^5 6.0 x 10^5 9.3 1.7 x 10^2 6.3 x 10^5 6.0 x 10^5 1.0 x 10^5 1.0 x 10^2 1.0 x 10^4 1.2 x 10^4 1.3 x 10^2 1.6 x 10^2 6.0 x 10^5 1.2 x 10^2 1.2 x 10^2 1.5 x 10^2 1.6 x 10^2 6.0 x 10^5 1.2 x 10^2 1.2 x 10^2 1.3 x 10^2 1.6 x 10^2 6.0 x 10^5 1.2 x 10^2 1.2 x 10^2 1.5 x 10^2 1.6 x 10^2 6.0 x 10^5 1.2 x 10^2 1.2 x 10^2 1.5 x 10^2 1.6 x 10^2 6.0 x 10^5 1.2 x 10^2 1.2 x 10^2 1.5 x 10^2 1.5 x 10^2 1.6 x 10^2 1.2 x 10^2 1.2 x 10^2 1.2 x 10^2 1.3 x 10^2 1.3 x 10^2 1.5 x 10^2 1.5 x 10^2 1.5 x 10^2 1.5 x 10^2		ЕКП	Generalized Scenario C 743	Total	2.4	9.7 x 10 ⁻¹	6.5 x 10 ⁻³
Mass Discharge (sum of all components)	6	EDII	Comprehized Scanonic CAA		9.4	2.7 x 10 ⁻²	1.4 x 10 ⁻⁴
Total Generalized Scenario C^^ Discharge (sum of all components) 9.3 1.7 x 10^-2 6.3 x 10^-5 6.0 x 10^-5 6.0 x 10^-5 7.4 1.6 x 10^-2 6.0 x 10^-5 6.0 x 10^-5 6.0 x 10^-5 7.4 1.6 x 10^-2 6.0 x 10^-5 1.9 x 10^-2 1.0 x 10^-5 1.0 x 10^-5 1.1 x 10^-7 1.2 x 10^-9 1.2 x 10^-9 1.2 x 10^-9 1.3 x 10^-1 1.2 x 10^-9 1.3 x 10^-1 1.3 x 10^-1 1.3 x 10^-1 1.3 x 10^-1 1.4 x 10^-1 1.5 x 10^-1	0	EKII	Generalized Section 6		4.9		8.7×10^{-3}
SEE Generalized Scenario C Generalized Scenario C	7	EDH	Canaralized Scanario CAA		9.3	1.7 x 10 ⁻²	6.3 x 10 ⁻⁵
8 ERH Generalized Scenario C*** (SDC) 9 ERH Generalized Scenario C * (SDC) 10 ERH Generalized Scenario C 11 SEE Generalized Scenario C 12 SEE Generalized Scenario C 13 SEE Generalized Scenario C ^^ 13 Generalized Scenario C ^^ 14.6 7.3 x 10 ⁻² 3.4 x 10 ⁻⁴ 1.3 2.8 1.0 x 10 ⁻⁵ 1.9 x 10 ⁻² 1.8 x 10 ⁻⁷ 1.2 x 10 ⁻⁹ 2.9 x 10 ⁻⁴ 1.1 x 10 ⁻⁷ 7.1 x 10 ⁻¹⁰	,	EKII			7.4	1.6 x 10 ⁻²	6.0×10^{-5}
9 ERH Generalized Scenario C * (SDC) 4.9 x 10 ¹ 1.3 x 10 ⁻¹ 9.6 x 10 ⁻⁴ 10 ERH Generalized Scenario C 1.2 5.4 x 10 ⁻² 1.6 x 10 ⁻⁴ 11 SEE Generalized Scenario C 4.6 7.3 x 10 ⁻² 3.4 x 10 ⁻⁴ 12 SEE Generalized Scenario C 1.3 2.8 1.0 x 10 ⁻⁵ 1.9 x 10 ⁻² 1.8 x 10 ⁻⁷ 1.2 x 10 ⁻⁹ 2.9 x 10 ⁻⁴ 1.1 x 10 ⁻⁷ 7.1 x 10 ⁻¹⁰	8	ERH	Generalized Scenario C*** (SDC)	· ·	3.2×10^{1}	2.1	1.9 x 10 ⁻²
10 ERH Generalized Scenario C 1.2 5.4 x 10 ⁻² 1.6 x 10 ⁻⁴ 11 SEE Generalized Scenario C 4.6 7.3 x 10 ⁻² 3.4 x 10 ⁻⁴ 12 SEE Generalized Scenario C 1.3 2.8 1.0 x 10 ⁻⁵ 1.9 x 10 ⁻² 1.8 x 10 ⁻⁷ 1.2 x 10 ⁻⁹ 2.9 x 10 ⁻⁴ 1.1 x 10 ⁻⁷ 7.1 x 10 ⁻¹⁰	9	ERH	Generalized Scenario C * (SDC)	components)	4.9×10^{1}		9.6 x 10 ⁻⁴
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	10	ERH			1.2	5.4 x 10 ⁻²	1.6 x 10 ⁻⁴
13 SEE Generalized Scenario C ^^ $ \frac{1.9 \times 10^{-2}}{2.9 \times 10^{-4}} \frac{1.8 \times 10^{-7}}{1.1 \times 10^{-7}} \frac{1.2 \times 10^{-9}}{7.1 \times 10^{-10}} $	11	SEE	Generalized Scenario C		4.6	7.3 x 10 ⁻²	3.4 x 10 ⁻⁴
2.9 x 10 ⁻⁴ 1.1 x 10 ⁻⁷ 7.1 x 10 ⁻¹⁰	12	SEE	Generalized Scenario C		1.3		
2.9 x 10 ⁻⁴ 1.1 x 10 ⁻⁷ 7.1 x 10 ⁻¹⁰	12	CEE	Cananalized Cooperis C AA		1.9 x 10 ⁻²	1.8 x 10 ⁻⁷	1.2 x 10 ⁻⁹
	13	SEE	Generalized Scenario C 777		2.9 x 10 ⁻⁴		7.1 x 10 ⁻¹⁰
	14	SEE	Generalized Scenario D		9.7 x 10 ⁻²		

Notes:

6.3 SUMMARY OF KEY OBSERVATIONS

In reviewing the information presented above in Sections 6.1 and 6.2, the following are of note:

- Documents from 182 applications were collected and reviewed, which included 87
 electrical resistance heating, 46 steam-based heating, 26 conductive heating, and 23 other
 heating technology applications conducted between 1988 and 2007. This information
 indicates that a significant number of applications have occurred and this reflects the
 acceptance of in situ thermal technologies as viable source zone treatment options.
- Approximately half of the 182 applications have been implemented since 2000, and over half of those were ERH systems. ERH applications outnumber all other applications

¹ Mass discharge calculations were based on monitoring well data from the documentation.

² Mass discharge calculations were based on monitoring well data from the documentation, discrete-depth sampling data, or a combination of discrete-depth sampling data and monitoring well data.

^{*} Mass discharge calculations were base on discrete-depth sampling data only.

^{**} Mass discharge calculations were based on monitoring well data analyzed solely by ASU personnel.

[^] Mass discharge calculations were performed for discrete-depth sampling data only and discrete-depth sampling data with monitoring well data.

^{^^} Mass discharge calculations were performed for two different geologic settings: 1) shallow, and 2) deep and/or intermediate.

SDC – supplemental data collection site for this project

since 2000 by about a factor of three. There also seems to be a recent trend in the increasing use of conductive heating and decreasing use of steam-based heating.

- There seems to be a differentiation of the technologies occurring, with it being better understood that steam and ERH are primarily limited to operating temperatures at about the atmospheric boiling point of water (100 C) or lower and conductive heating is the only option for achieving significantly higher temperatures than that.
- There seems to be a convergence towards relatively closely-spaced energy delivery points in the design of ERH and conductive heating systems. Spacing for most ERH and conductive energy delivery points was less than 20 ft (6 m), while steam application well spacing was usually greater than 20 ft (6 m).
- To date, most applications have been applied to relatively small treatment zones; 117 of 121 treated areas were <4x10⁴ ft² (<4000 m² or an acre) and two-thirds of those were <10⁴ ft² (<1000 m² or one-quarter acre treatment areas). It is also apparent that the spatial extents of many source zones are likely ill-defined prior to treatment. This results in under-sized target treatment zones, untreated source zone areas, and minimal beneficial impact to groundwater quality and mass discharge.
- The effect of geologic setting on performance is difficult to discern in this data set because most treatment systems were installed in layered settings, characterized as either primarily fine-grained materials with higher permeability lenses (Generalized Scenario B) or primarily permeable materials with finer-grained lenses (Generalized Scenario C). Thus, our understanding of system design parameters and operating conditions is limited to those scenarios.
- Most applications (independent of specific technology) lasted less than 6 months; there was little documentation as to the criteria or rationale used to determine the duration of operation. There was little indication that the duration of operation was linked to mass removal-, groundwater quality-, or soil concentration-based criteria.

In using the Summary Tables, practitioners, regulators, and site owners can anticipate the likely performance of thermal-based source zone treatment technologies at their sites. The tables link design, operating condition, and performance experience a small number of generalized geologic scenario site descriptors. The user can choose the generalized scenario that most closely resembles their site and can quickly assess:

- a) how the technology has been applied to date in that type of setting,
- b) the designs employed,
- c) the operating conditions,
- d) the performance monitoring that results are based on,
- e) the performance observed,
- f) indicators of success at other sites, and
- g) reasonable bounds on expected performance.

With respect to performance as measured by groundwater quality improvement and mass discharge reduction:

- Data from the five supplemental data collection sites indicated that a 100x order-of magnitude reduction was achievable if the source zone was adequately delineated and fully encompassed during treatment and if the system was operate for a sufficient period of time. Reductions of less than 100x where seen if the system was not operated for a sufficient period of time and at sites where the source zone was not fully encompassed a reduction of <10x was typical.
- For sites with a concentration reduction of 100x or more, the final groundwater
 concentrations could be less than 100 ug/L for individual constituents which then could
 correspond to a mass discharge of 1E-01 kg/yr or less. This type of treatment is desirable
 and can be achieved if the treatment is applied to the complete source zone and operated
 for a sufficiently long period of time.
- Further analysis of the data set focused on mass discharge reduction and its correlation
 with geology and maximum treatment temperature. Correlations between mass discharge
 reduction and geology were investigated, however, based on the number of sites with
 usable data and the fact that many had similar generic geological descriptions, it was not
 possible to correlate these.
- Temperature was one of the significant operational variables for thermal treatments. For each site, the maximum representative temperature or the highest temperature that was achieved throughout most of the treatment zone and held for at least one day was recorded (see Table 5.1). Analysis of the data indicated that contaminant concentration reductions ranged from <10x to 100x and the maximum representative temperatures achieved for each site ranged from 89°C to 100°C. Based on available data, no correlation was found, suggesting achieving a target temperature is insufficient to achieve good clean-up, and that application duration, in combination with the treatment zone temperature and treatment zone size likely control the performance.

7.0 IMPLEMENTATION ISSUES

The purpose of the study was to summarize knowledge on the performance of in-situ heating technologies. The approach, as it pertains to this project, was to identify sites where thermal technologies have been applied and collect and synthesize as much of the available data/documentation for those sites, thus allowing for knowledge on how often each individual technology was being applied. The most challenging implementation issue was a lack of sufficient documentation for most of the 182 applications identified.

8.0 REFERENCES

- National Research Council. 2004. Contaminants in the Subsurface: Assessment and Remediation. NRC Press. Washington DC. http://www.nap.edu/books/030909447X/html.
- Johnson, P.C. and Alleman, B.C., 2004. White Paper on Development of a Preliminary Assessment Document For In-Situ Thermal Technologies. Submitted to ESTCP October 2004.
- Triplett Kingston, J.L., 2008. "A Critical Evaluation of In-Situ Thermal Technologies." Ph.D. dissertation, Arizona State University, Tempe, AZ.
- USEPA. 2004. In Situ Thermal Treatment of Chlorinated Solvents: Fundamentals and Field Applications. EPA 542-R-04-010.http://www.clu-in.org/s.focus/c/pub/i/1059/

9.0 APPENDICES

Appendix A

Points of Contact

POINT OF CONTACT Name	ORGANIZATION Name Address	Phone Fax E-mail	Role in Project	
Eric Foote	Battelle 505 King Ave Columbus, OH 43201	Ph: (614) 424-7939 Fax: (614) 458-7939 foote@battelle.org	Project Technical Lead	
Dr. Paul C. Johnson	Arizona State University Department of Civil Engineering PO Box 875306, ECG-252 Tempe, AZ 85287-5306	Ph: (480) 965-9115 Fax: (480) 965-0557 paul.c.johnson@asu.edu	Project Technical Lead	
Shane Williams	Battelle 505 King Ave Columbus, OH 43201	Ph: (614) 424-5792 Fax: (614) 458-5792 williamsts@battelle.org	Team Member	
Dr. Jennifer Triplett Kingston	Haley & Aldrich 8735 Rosehill Rd., Ste. 340 Lenexa, KS 66215	Ph: 913-217-6905 Fax: 913-217-6955 jkingston@haleyaldrich.com	Team Member	
Dr. Paul Dahlen	Arizona State University Department of Civil Engineering PO Box 875306, ECG-252 Tempe, AZ 85287-5306	Ph: (480) 965-0055 Fax: (480) 965-0557 Paul.dahlen@asu.edu	Team Member	
Travis Shaw	US Army Corps of Engineers 4735 East Marginal Way South Seattle, WA 98134-2385	Ph: (206) 764-3527 Fax: (206) 764-3706 Travis.c.shaw@usace.army.mil	COR	

Appendix B

State-of-the-Art Technology Descriptions

Appendix C

Data Logs

Appendix D

Supplemental Site Investigation Reports Site Specific Demo Plan and Data Analysis Reports

Appendix E

Quality Assurance Project Plan

Appendix F

Uncertainty Analysis for Mass Discharge Calculations

9.0 APPENDICES

Appendix A

Points of Contact

POINT OF	ORGANIZATION	Phone	
CONTACT	Name	Fax	Role in Project
Name	Address	E-mail	
Eric Foote	Battelle 505 King Ave Columbus, OH 43201	Ph: (614) 424-7939 Fax: (614) 458-7939 foote@battelle.org	Project Technical Lead
Dr. Paul C. Johnson	Arizona State University Department of Civil Engineering PO Box 875306, ECG-252 Tempe, AZ 85287-5306	Ph: (480) 965-9115 Fax: (480) 965-0557 paul.c.johnson@asu.edu	Project Technical Lead
Shane Williams	Battelle 505 King Ave Columbus, OH 43201	Ph: (614) 424-5792 Fax: (614) 458-5792 williamsts@battelle.org	Team Member
Dr. Jennifer Triplett Kingston	Haley & Aldrich 8735 Rosehill Rd., Ste. 340 Lenexa, KS 66215	Ph: 913-217-6905 Fax: 913-217-6955 jkingston@haleyaldrich.com	Team Member
Dr. Paul Dahlen	Arizona State University Department of Civil Engineering PO Box 875306, ECG-252 Tempe, AZ 85287-5306	Ph: (480) 965-0055 Fax: (480) 965-0557 Paul.dahlen@asu.edu	Team Member
Travis Shaw	US Army Corps of Engineers 4735 East Marginal Way South Seattle, WA 98134-2385	Ph: (206) 764-3527 Fax: (206) 764-3706 Travis.c.shaw@usace.army.mil	COR

ER-0314 Appendix A

APPENDIX B

State-of-the-Art Technology Descriptions for:

- Thermal Conduction Heating
- Electrical Resistance Heating
- Steam Enhanced Extraction
- Hot Air/Steam Injection Thermal Remediation Using Large Diameter Auger (LDA) In-Situ Soil Mixing

ER-0314 Appendix B

Thermal Conduction Heating

By

Gorm Heron (TerraTherm) and Ralph Baker (TerraTherm) 10 Stevens Road Fitchburg, MA 01420

1. Overview of Technology

1.1 *One paragraph description of the state of the thermal application*

In-Situ Thermal Desorption (ISTD) is the simultaneous application of heat by thermal conduction heating (TCH) and vacuum to remediate organic source zones. The technology has been applied at full scale to remediate a wide variety of contaminants, ranging from low-boiling VOCs and CVOCs to high-boiling PAHs, PCBs and dioxins. It has been applied to treat both vadose and saturated zone sites, as well as fractured media (clay and rock). Virtually every project achieves much lower post-treatment concentrations than the goals. Treatment costs have been lowered dramatically by technology simplifications.

1.2 New improvements to the technology over the past 5 years

Over the past five years, ISTD has undergone a number of technology improvements. The heater wells have become simpler, less expensive and more able to resist corrosive conditions. They are amenable to installation by most available drilling methods, with installation rates in the range of 200 - 400 ft per day per rig. Control systems have become simplified. Off-gas treatment can be accomplished by a wider array of components, with the choice depending on project requirements. ISTD has been performed over a wide range of thermal well spacings and time durations, and the energy requirements for a range of subsurface conditions are well understood. As treatment costs have decreased, more CVOC DNAPL sites have been treated, where initially ISTD was mostly used for PCB soil decontamination.

2. Energy Delivery/Heating Information

2.1 Basic conceptual overview of the energy delivery/soil heating process (i.e. a conceptual drawing showing the basic components and a simple conceptual time-series of energy transfer/heating in the subsurface)

Figure 1 shows a generic sketch of a small In-Situ Thermal Desorption (ISTD) site.

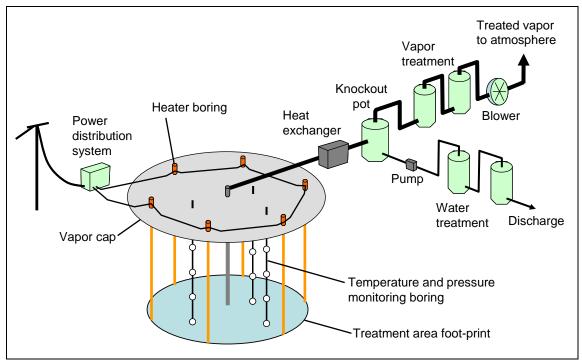


Figure 1. Conceptual Sketch of In-Situ Thermal Desorption System.

A typical site has the following components:

- Transformer to supply 480 V, 3-phase power.
- Simple electrical distribution switchgear and controllers for the heaters.
- Cables to all ISTD heater borings.
- Vertically installed heater borings, with a simple resistive heater element hanging inside a 3" diameter steel casing, either driven in or installed with grout and sandpack.
- Vapor recovery wells (horizontal or vertical, or both, depending on geology).
- Where necessary for hydraulic control, groundwater extraction wells or a physical hydraulic barrier.
- Temperature and pressure monitoring wells.
- An off-gas and water treatment system with varying components depending on contaminants and expected mass loading.

Energy transfer is by thermal conduction and fluid convection around the heaters, as the heater borings are heated to temperatures above 500°C. More detail is provided in LaChance et al.¹.

.

¹ LaChance, J., G. Heron and R. Baker. 2006. "Verification of an Improved Approach for Implementing In-Situ Thermal Desorption for the Remediation of Chlorinated Solvents." *Remediation of Chlorinated and Recalcitrant Compounds: Proceedings of the Fifth International Conference* (May 22-25, 2006). Battelle, Columbus, OH.

A typical operational period, using treatment to the boiling point of water as an example is provided in Figure 2.

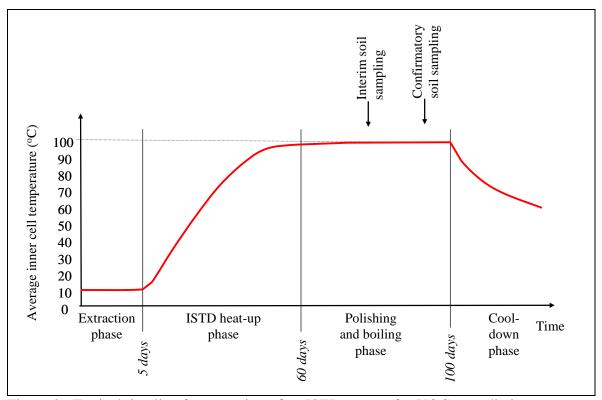


Figure 2. Typical timeline for operation of an ISTD system for VOC remediation.

The extraction phase is used to document pneumatic control and to demonstrate that the off-gas treatment system meets the regulatory demands for contaminant removal efficiency. If groundwater is extracted, this period is also used to document hydraulic control and sufficient water treatment.

During the heat-up phase, ISTD power is injected into each heater at rates of approximately 300-350 W per linear ft of heater, and the ground heats up due to the temperature gradients created and convection of heated fluids such as steam, air, and water.

The polishing phase is primarily a phase where steam is generated in-situ, and steam stripping is used to lower contaminant concentrations to below target levels. It often overlaps with heating of the bottom-most depths, and/or areas that lag behind the average heating, to the target temperature.

Interim and final confirmatory soil sampling (and groundwater sampling, where required) is used to assess the treatment efficacy. Once the data comes back from the laboratory and shows that the objectives are met, a short cool-down period follows, where steam is removed from the subsurface and the site is cooled to an acceptable final temperature. Then, the ISTD equipment and the well-field are decommissioned.

2.2 Any available information on relationship or current understanding between energy delivery and heating rates (i.e. efficiency of energy conversion to heat)

To avoid overheating of wells and heater materials, the heater element power input is limited to below 400 W/ft of heater. For instance, a 30-ft long heater will only be able to supply on the order of 10-12 kW of energy to the subsurface. This energy is conducted away from the heaters, and partially used to vaporize groundwater into steam.

The efficiency of converting electric power to heat is around 99% or better – basically all the energy is deposited in the heater elements, with minor losses in switchgear and cables. Since the heating mechanism is based on the Ohmic resistance of the heater rods, which are fully imbedded in the treatment volume, this is a direct and highly efficient way of heating.

Heat losses come from conduction of heat to the surface, perimeter, and bottom, where ISTD heaters typically extend between 2 and 5 ft outside the target treatment zone to ensure heating of the entire volume to the target temperature. These heat losses are inevitable and part of any heating technology where sufficient care is taken to treat the edges of the target volume.

The heating rate is typically calculated for the coolest locations within the target treatment zone, and is directly dependent on the spacing between neighboring heaters (located in a triangular pattern). Typical durations are shown in table 1.

Table 1. Typical duration of ISTD operation as a function of heater spacing.

Heater boring	Operational duration for CVOC
spacing (ft)	source zones (days)
10	60-80
12	90-120
15	120-180
20	300-400

Actual durations are site-specific, and depend on factors such as:

- Initial saturation (the wetter the longer it takes).
- Porosity (the higher the longer it takes).
- Water table position.
- Groundwater seepage velocity and recharge (if a hydraulic barrier is not used).
- Mineral composition (minor differences between common minerals).
- Initial contaminant mass.
- Target contaminant concentration (the lower the longer it takes).

If the project schedule is critical, the heater spacing is chosen for a given site to match the available time. This is typically done for Brownfield sites such as the Richmond site², where a property transfer and/or construction of new homes drive the schedule.

2.3 Limitations of the energy delivery/heating process (i.e. what temperatures can be reached?, how even is the heat/energy distribution?, do natural phenomena limit the heating?)

For compounds with boiling points below 150°C, steam stripping and vaporization are effective mechanisms, and the boiling point of water is used as the target treatment temperature.

For sites where dewatering is undesirable or not practical, the presence of water will buffer the temperature to the steam temperature, which is 100°C above the water table and increases with depth and pressure below the water table. At 33 ft depth below water, where the pressure is 2 atm (14.6 psig or 29.2 psia), the steam temperature is 120°C.

For SVOCs such as PCB, coal tar, PAH and creosote, higher temperatures are used as the target treatment temperature. The target temperatures are in the range of 200°C to 350 °C, depending on the physical and chemical properties of the limiting contaminant. Heating to these temperatures involves removing or boiling all of the soil moisture, which enables heating the dry soil/sediment above steam temperatures. Due to the high treatment efficiency (including accelerated kinetics of oxidation and pyrolysis³) at temperatures below 325 °C, sites are rarely heated beyond this temperature.

² LaChance et al. 2006. Ibid.

_

³ Baker, R.S. and M. Kuhlman. "A Description of the Mechanisms of In-Situ Thermal Destruction (ISTD) Reactions." In: H. Al-Ekabi (Ed.), *Current Practices in Oxidation and Reduction Technologies for Soil and Groundwater*. Presented at the 2nd International Conf. on Oxidation and Reduction Technologies for Soil and Groundwater, ORTs-2, Toronto, Ontario, Canada, Nov. 17-21, 2002.

The most critical factors controlling the ability to heat a site to the target temperatures are:

- Groundwater flow, which can lead to cooling where water enters the treatment volume. Each design must address the potential for groundwater influx and cooling. In certain clay formations, permeable fractures can lead to rapid groundwater flow and cooling, as observed at a site in Ohio⁴. Other sites with groundwater zones with significant flow rates may be addressed either by limiting the flow using pumping or barriers, or by combining ISTD with the injection of steam to heat the more permeable zones⁵.
- Air inflow due to the applied vacuum, leading to cooling. This is typically very minor due to the low heat capacity of atmospheric air, and the modest flow rates.
- Target zone geometry (very shallow sites and irregularly shaped sites take longer due to large surface areas and heat losses, deep sites and equidimensional sites heat faster due to low heat losses).

Each thermal design involves a careful review of the geometry, and specifically the hydrogeology and potential impacts of water flow on the heating regime. Where needed, a detailed 3D numerical simulation is used to evaluate impacts and worst-case scenarios.

2.4 Unique advantages/disadvantages of this energy delivery/heating approach for contaminant removal or destruction?

Heating depends primarily on thermal conduction – therefore the "sweep" is highly uniform. Clay layers, sand zones, and gravel zones heat up at very similar rates due to small variations in thermal conductivity (varying by a factor of only approximately three from sand to clay) and heat capacity of various minerals, sediments, soils, and rocks. This is the primary advantage of ISTD – that our heating pattern and therefore treatment duration is highly predictable. This allows the treatment performance (as determined by reduction in contaminant concentrations) to be highly predictable as well.

A unique advantage is that the ISTD heaters are simple steel rods which can be as long and deep as the site requires. The same heaters are used in the oil field for heating zones with thicknesses over 500 ft. The heaters are in 3-inch simple casings, and the borehole size does not increase as the heaters need to go deeper. Since the power used to generate

_

⁴ LaChance, J.C., R.S. Baker, J.P. Galligan, and J.M. Bierschenk. 2004b. "Application of 'Thermal Conductive Heating/In-Situ Thermal Desorption (ISTD)' to the Remediation of Chlorinated Volatile Organic Compounds in Saturated and Unsaturated Settings." Paper 2B-21, in: A.R. Gavaskar and A.S.C. Chen (Eds.), *Remediation of Chlorinated and Recalcitrant Compounds—2004*. Proceedings of the Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2004). ISBN 1-57477-145-0, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

⁵ Baker, R.S. and G. Heron. 2004. "In-Situ Delivery of Heat by Thermal Conduction and Steam Injection for Improved DNAPL Remediation." Paper 2B-18, in: A.R. Gavaskar and A.S.C. Chen (Eds.), *Remediation of Chlorinated and Recalcitrant Compounds—2004*. Proceedings of the Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2004). ISBN 1-57477-145-0, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore

heat in each heater flows through the entire length of the heater, it puts out the same power density along the length of the heater, leading to relatively uniform heating over the length of the heater, despite differences in the sediment/soil/rock properties with depth. This can allow for uniform heating of deep sites with simple surface controls. One example of this, with ISTD heating to 110 ft, is the recent project in Alhambra, CA⁶.

A potential disadvantage is the ability to heat a zone with groundwater flow carrying the heat away or cooling by entry of cold water. As discussed above, such cooling has to be either limited by means of a barrier (hydraulic or physical), overcome by injecting steam into the highly conductive zones, or overcome by adding more ISTD heaters to increase the power density in such zones. A good and detailed analysis of the site hydrogeology is key to managing this potential disadvantage.

For SVOCs, heating to temperatures above boiling can lead to significant in-situ destruction of contaminants. This may reduce the mass loading on the off-gas treatment system. Mechanisms and reaction processes are described by Baker and Kuhlman⁷.

2.5 *Is the process applied differently if the contaminants are below the water table?*

In principle, no. The ISTD heaters are installed and operated in the same manner. But the hydrogeology issues and potential for groundwater flow discussed above become important. In addition, vapor extraction and control becomes dominated by steam generation and capture, as the heat creates steam. An analysis and example of this for a site where ISTD was used to treat CVOCs 15 ft below the water table is discussed by LaChance et al.⁸.

As the heat travels horizontally away from the heater borings, vapors are generated by insitu boiling of groundwater (and NAPL, if present). The generated vapors travel towards the heaters, and upward along the heater borings where increased gas phase permeability is created by the drying in the immediate vicinity of each heater. The vapors are captured and extracted by vapor collectors located in the vadose zone. This continuous removal of VOC mass, starting a few hours after the onset of heating, is a key mechanism for removal of VOCs from below the water table.

For SVOCs below the water table, water presence can prevent heating to above the boiling point. Therefore, a site-specific analysis of possible treatment efficacy with and without dewatering is performed. The cleanup standard typically drives this, as complete contaminant removal to very low soil concentrations will require dewatering and heating to above boiling, and less aggressive treatment goals such a removal of all VOC

⁶ Bierschenk, J.M., R.S. Baker, R.J. Bukowski, K. Parker, R. Young, J. King, T. Landler, and D. Sheppard. 2004. "Full-Scale Phase 1a Results of ISTD Remediation at Former Alhambra, California Wood Treatment Site." Paper 4A-09, in: A.R. Gavaskar and A.S.C. Chen (Eds.), *Remediation of Chlorinated and Recalcitrant Compounds—2004*. Proceedings of the Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2004). ISBN 1-57477-145-0, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

⁷ Baker and Kuhlman, Ibid.

⁸ LaChance et al 2006. Ibid.

components and stabilization of the leftover NAPL phase allows treatment at the boiling point⁹.

3. Process Configuration Information

3.1 Generic lay-out of the process showing spacings (heaters, electrodes, wells, etc.) of in situ components for a "typical" application

Heaters are typically located in a triangular pattern as shown on Figure 3.

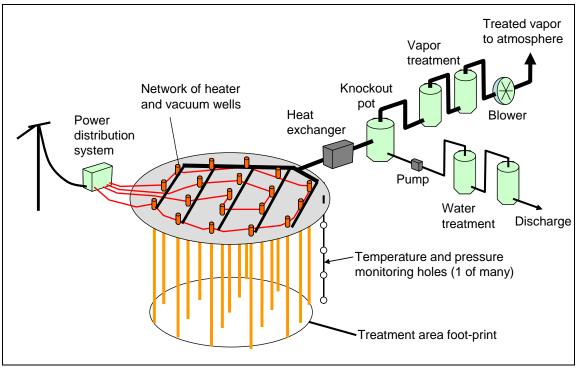


Figure 3. Generic layout of heater borings and process equipment for an ISTD project.

The spacing between heater borings is discussed in Section 1.2. For VOC sites, the heater spacing typically varies between 12 and 20 ft. For SVOC sites heated to above boiling, a typical heater spacing is between 6 and 12 ft.

Vapor and water extraction wells can either be vertical wells within the pattern (heated or unheated), or horizontal or angled wells located in optimized positions to capture the heated fluids. Figure 4 illustrates a cross-sectional view of a site where steam vapors are extracted near each heater (which is used for sites with high NAPL saturations to minimize condensation during heating), and a number of horizontal vapor extraction wells located in the vadose zone.

-

⁹ Baker, R.S., D. Brogan and M. Lotti. 2006. "Demonstration of Tailored Levels of In-Situ Heating for Remediation of a Former MGP Site." Proceedings of the International Symposium and Exhibition on the Redevelopment of Manufactured Gas Plant Sites (MGP2006), Reading, England, April 4-6, 2006. *Journal of Land Contamination and Reclamation*, 14(2):335-339.

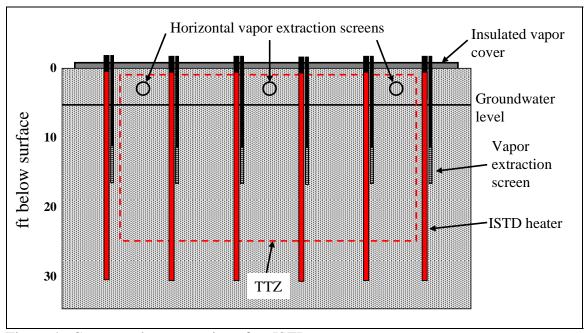


Figure 4. Conceptual cross-section of an ISTD treatment zone.

Each site is analyzed in detail, and the vapor and water recovery wells and extraction approach is determined based on site-specific conditions.

A vapor cover is typically used when treating to shallow depths. The cover serves three purposes:

- 1. It provides thermal insulation and prevents contaminants from condensing near the land surface, which will occur if the soil is cool.
- 2. It prevents rainwater infiltration, which could lead to unwanted cooling of the treatment zone.
- 3. It provides a vapor seal and increases the radius of influence of the vapor extraction screens.

Temperature and pressure monitoring wells are simple vertical borings used to document performance and pneumatic control during treatment. These are located inside and outside the treatment area, typically at different distances from the heaters to illustrate the heating progression.

3.2 Generic lay-out of above-ground components, showing the footprint of a "typical" application

The above-ground equipment varies from site to site depending on treatment area size, volume, nature of contamination, and local regulatory requirements for treating the effluents. A typical simple system is shown in Figure 5.

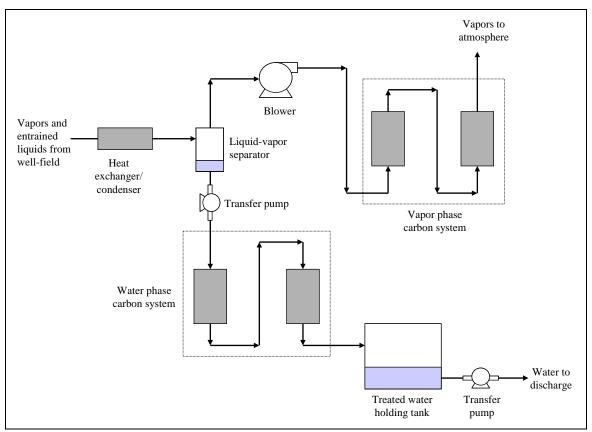


Figure 5. Example treatment system for fluids recovered during ISTD implementation.

For sites with large contaminant mass loading, the vapor treatment is often done using thermal oxidation or other methods capable of handling the high recovery rates.

The surface layout is dictated by site-specific conditions such as the location of utility connections, obstructions such as buildings, and an effort to minimize the piping runs from the well field area to the treatment process. For small sites, the treatment system is placed on a trailer or in a container, and mobilized to the site as one unit. For sites requiring large treatment components, individual process equipment units may be mobilized and connected at the site.

3.3 Special utility requirements (power, water, surface cover, security, etc.)

The required utilities are:

- Power (480 V, 3-phase).
- Water (for drilling, cleaning, office trailer, and sometimes for the process if using a cooling tower or wet acid gas scrubbing).
- Gas or diesel when fuel is used for either off-gas treatment (such as an oxidizer) or for generating power as a back-up.
- Telephone and internet for communications and process controls.

3.4 Is the process configured differently if the contaminants are below the water table?

This depends on whether dewatering is necessary, as discussed in Section 1.5. Often, treatment below the water table involves groundwater extraction and treatment.

4. Process Information

4.1 Typical durations of applications, and how does one decide to turn it off?

For VOC sites, typical durations are between 2 months and 1 year, depending on site-specific requirements and the chosen heater spacing (Section 1.2).

For SVOC sites, typical durations are between 6 months and 1 year.

Performance is typically based on soil concentrations, since soil can be readily sampled during operation, using methods identical or similar to those tested and documented by Gaberell et al.¹⁰. The criteria for turning off the system are typically the same as the criteria for successful remediation – the system is operated until the client has regulatory approval that the remedy is complete.

Sampling of soil eliminates a classical problem – groundwater rebound occurring after the treatment. By sampling the phase from where rebound would originate (by desorption and diffusion out of bypassed solids), the risk of post-remediation contaminant concentration increases is minimized/eliminated.

_

¹⁰ Gaberell, M., A. Gavaskar, E. Drescher, J. Sminchak, L. Cumming, W-S. Yoon, and S. De Silva. 2002. Soil Core Characterization Strategy at DNAPL Sites Subjected to Strong Thermal or Chemical Remediation. Paper 1E-07, in: A.R. Gavaskar and A.S.C. Chen (Eds.), *Remediation of Chlorinated and Recalcitrant Compounds*—2002.

For some sites without specific numeric cleanup standards, other parameters are used to determine when to cease operation:

- Groundwater concentrations (although these are hard to use due to the complex chemistry at elevated temperatures and difficulty in collection of representative samples without loss of the contaminants). Groundwater samples can potentially show you more impressive remediation results due to the low solubility of most VOCs in hot water. Basing the decision to stop treatment on such samples may be risky and rebound could occur during cool-down.
- Target treatment temperature. This would be applied to the coolest locations within the target treatment zone and used to focus the heating process towards the end of the operational period. Laboratory treatability tests can be use as guidance for selection of the target temperature and thereby provide an indication of remedial completeness when the target temperature is reached.
- Energy balance calculation showing steam stripping and generation of a certain amount of steam (typically related to the pore volume of the treatment zone). The amount of steam generation/stripping needed can be estimated based on laboratory testing, and depends on initial concentrations and the specific remediation goals.
- Diminishing recovery of contaminants while ensuring that the heating process and fluid extraction process are operated according to specifications. This can be risky, since diminishing returns can be reached without treatment of the entire targeted volume, as documented as an interim result at the Young-Rainey STAR project¹¹, where the discovery of a cool area led to focused heating and more complete remediation after the vapor recovery had dropped to low levels temporarily.

Site-specific performance goals are negotiated and typically made part of the contract for the ISTD project. They typically tie directly into the regulatory demands for site closure or remedy acceptance, such that the client and the ISTD contractor work towards the same objective.

4.2 Typical monitoring/diagnostics for the technology during operation (i.e. how do you know it's working?)

The monitoring is based on:

- Hydraulic control (documented using groundwater elevation monitoring).
- Pneumatic control (documented using pressure monitoring).
- Subsurface temperatures (documented using thermocouples). This includes thermocouples located in a subset of the heater borings, used for the thermostat control of the heater elements.

-

¹¹ Heron, G., Carroll, S., and Nielsen, S.G.D., 2005. Full-Scale Removal of DNAPL Constituents using steam enhanced extraction and electrical resistance heating. Ground Water Monitoring and Remediation, 25(4): 92-107.

- Contaminant removal rates and totals (estimated by sampling the effluent vapor, water, and NAPL). The totals are compared to initial mass estimates, considering the typical uncertainties of such estimates. However, the total mass recovered is never used to determine when to cease operation, due to the uncertainties in initial mass estimates.
- Vapor treatment efficacy (based on vapor samples before and after the treatment unit).
- Water/condensate treatment efficacy (based on water samples before and after the treatment unit).
- Interim sampling of soil and/or groundwater within and around the treatment zone (showing reductions in contaminant concentrations compared to original levels).
 These samples are typically the most important for determining when to cease operation.
- Final confirmatory sampling.

In addition, site-specific monitoring related to health and safety and community monitoring may be conducted.

4.3 Post-treatment issues (time period needed for cooling/access/etc.)

This is site-specific and depends on future site use. Typically, live steam is removed from the subsurface over a period of 1 to 2 weeks, while the site starts the cool-down. At some sites, cold water is injected to assist with cooling. When demobilization begins, the subsurface temperatures may be as high as 90°C. Removal of the surface cover enhances the cooling. Demobilization is typically complete between 1 and 2 months after completing the remediation.

5. Technology Selection

5.1 For what scenarios is the technology ideally suited?

Generally, ISTD is favored by the following conditions:

- Recalcitrant contaminants not easily addressed by Monitored Natural Attenuation (MNA), Soil Vapor Extraction (SVE), or pump and treat. The most suited contaminants would include most CVOCs, DNAPL, creosote, coal tar, and PCBs.
- Large contaminant mass and concentrations, with significant NAPL presence (so less aggressive, cheaper methods are ineffective).
- Stringent cleanup standards. ISTD treats to very low final concentrations, largely independent of the starting mass and concentration.
- Sites with a driver to clean within a relatively short time-frame (where long-term solutions suffer due to insecurity about when they can be shut off).
- Sites with target volumes above 3,000 cubic yards (the unit cost is higher for small sites).

- Sites deeper than 10 ft (our simple heaters can readily be extended deeper without much additional cost).
- SVOC sites where excavation is unpractical or expensive (so we can compete on a unit cost basis).

Most sites treated using ISTD have been CVOC DNAPL sites or SVOC sites with PCBs, coal tar, or creosote.

ISTD is potentially ideally suited for fractured rock sites. All know bedrock types have sufficient thermal conductivity to allow for effective heating using ISTD. The combination of very predictable heating and a high density of wells/borings for extraction, such that all or the majority of the fractures can be contacted and used for extraction of the generated steam, makes this a very promising option.

5.2 *Under what conditions is the technology "challenged"?*

The following conditions challenge the applicability of ISTD:

- Very shallow and wide-spread contamination. For such sites, heat losses may become prohibitive due to the large surface area. The on-site version of ISTD, termed In-Pile Thermal Desorption (IPTD), may apply to some of these sites.
- Contamination present under structures where vertical drilling is prohibited. Heating can readily be done using angled or horizontal borings, but the complexity and cost of the drilling and installation increases significantly compared to vertical installations.
- SVOCs below the water table with stringent cleanup standards and difficulty of dewatering. If the water prohibits drying and heating to above steam temperatures, complete treatment for SVOCs to low levels may not be possible.
- Sites with high groundwater flow rates and difficulty of controlling it during operation. As described in Section 1.2, management of the groundwater flux or additional heating of the high-flow zones may be used to overcome this challenge.

Typical concerns about geotechnical stability and damage to foundations, buildings, or underground utilities are dealt with relatively easily on a site-specific basis, and have not been a significant barrier to ISTD implementation.

Electrical Resistance Heating By Greg Smith (Thermal Remediation Services, Inc.)

1.0 Overview of Technology

1.1 One paragraph description of the state of the thermal application

Electrical Resistance Heating (ERH) is an aggressive in situ thermal remediation technology that was developed by the U.S. Department of Energy from the original oil production technology to enhance vapor extraction remediation technologies in low permeability soils. Soil and groundwater are heated by the passage of electrical current through saturated and unsaturated soil between electrodes, not by conductive heating from the electrodes themselves. It is the resistance to the flow of electrical current that results in increased subsurface temperatures, and ERH is typically applied to the boiling point of the contaminant and water mixture. It is estimated that more than 75 ERH applications have been performed. Capacity to perform these projects has increased over the years, with as many as 15 to 20 of these applications now being performed at any given time, mainly in North America, with some European applications. ERH has been used to treat a wide variety of contaminants including VOCs, CVOCs (especially where light non-aqueous phase liquids (LNAPL) or dense non-aqueous phase liquids (DNAPL) are present), pesticides, and is now being applied to treat PAH compounds from manufactured gas plant sites and creosote from wood treating operations.

1.2 New improvements to the technology over the past 5 years

Technological improvements over the past 5 years have been in the area of equipment and mode of application. The modifications to the mode of application have incorporated physical, chemical and biological processes that have been observed to occur during ERH. Improvements made to the equipment include simplification of power control units (PCUs), improvements in electrode design, and modification of water drip systems to maintain soil moisture around electrodes.

Improvements have been made to the efficiency of operations, both from an installation and energy focus, but also from an operational focus. More maintenance-friendly condensers are now being used to control costs and improve efficiency. Various electrode designs have been developed over the years for a variety of applications. Most electrode designs incorporate vapor recovery in their design. Electrodes have been constructed from steel pipe, copper plate for heating distinct zones and sheet pile. Sheet pile electrodes allow for quick installation with little to no drilling wastes generated for disposal.

More robust, all-weather drip systems have been developed to maintain soil moisture in the vicinity of the electrodes. This allows for continuous all-weather operation in remote locations.

At the Ft. Lewis, Washington project, TRS was the prime contractor for what is believed to be the most-studied application of in situ thermal remediation to date. This work consisted of laboratory and field testing to evaluate the reductive dehalogenation mechanisms during ERH. At the time of this document preparation, much of this data is being evaluated and some additional studies are being conducted, however, some of the lessons learned from this project are being carried forward to incorporate reductive dehalogenation into the design of new applications.

Chemical processes that had not been considered for environmental remediation such as hydrolysis are now becoming the principal mechanism for cleanup for a variety of pesticides using ERH. Hydrolysis had not typically been considered a chemical process for groundwater remediation because at typical groundwater temperatures, the reaction is too slow. At temperatures that can easily be achieved using ERH, hydrolysis reaction rates increase by several orders of magnitude. For example, methylene chloride, which has a hydrolysis half life of 3,282 years at 15 °C, has a hydrolysis half life of 35 days at 100°C.

Physical reactions that provide enhancements to fluid recovery using ERH include a process that TRS calls steam bubble floatation. This process involves the formation of gas and vapor bubbles at the NAPL/water interface causing the NAPL to rise to the water table where it can be removed using multi-phase extraction. This process was used to recover heavy grease at Ft. Lewis, Washington and oil in Georgia.

2.0 Energy Delivery/Heating Information

2.2 Basic conceptual overview of the energy delivery/soil heating process (i.e. a conceptual drawing showing the basic components and a simple conceptual time-series of energy transfer/heating in the subsurface)

The components required to implement ERH include:

- Electrodes (steel pipe, copper plate, well points, sheet pile).
- Vapor recovery wells (which are typically co-located in the same boreholes as the electrodes).
- A steam and vapor collection system, including piping, blower, and condenser.
- A vapor treatment system.
- An ERH power control unit to condition power for application to the subsurface.
- A computer control system with modem for data acquisition and continuous remote monitoring and control of power.

The ERH electrodes conduct electrical energy into the subsurface and can be designed to allow independent control of the energy input to discrete depth intervals. Electrodes are typically constructed using either steel pipe or copper plate to treat distinct zones in the subsurface, such that multiple electrodes can be installed within the same boring. For some applications, sheet piling has been used as electrodes. Electrodes constructed using

steel pipe are installed in the subsurface in a manner similar to installing groundwater monitoring wells. In the electrically conductive intervals, the surrounding borehole annulus is packed with a conductive material, such as graphite and/or steel shot, to increase the effective (conductive) diameter of the electrode. In those portions of the subsurface where electrical resistance heating is not desired, the electrode construction materials are insulated and the surrounding annulus is filled with relatively non-electrically conductive materials such as sand or cement.

The electrodes provide the opportunity to heat discrete subsurface depth intervals. In applications having layered sequences, it may be desired to treat discrete layers separately or to create thermal barriers. ERH allows this flexibility by placing electrically conductive materials at discrete intervals within the same borehole in which the electrode is constructed. Based on the current state of the technology and experience, the practical minimum thickness of the discrete zone is 8 feet because of electrical fanning and thermal conduction.

Vapor recovery (VR) is accomplished using conventional vapor extraction techniques utilizing shallow wells installed either vertically or horizontally. Once steam and volatile contaminants have been collected by the VR system, the steam is condensed and the vapor is cooled to near ambient temperatures. Conventional vapor treatment techniques are used to adsorb or destroy the vapors. However, owing to temperatures resulting from application of ERH, the materials for the construction of the wells and headers must be able to withstand temperatures in the order of 100°C.

An ERH power control unit (PCU) is used to step-down standard line voltage for application as three or six separate electrical phases (as desired). The PCU includes isolation transformers that force ERH current to flow between the electrodes only, preventing ERH current from flowing to a distant electrical sink. Isolation transformers are so named because there is no conductive path between the isolated circuit and the rest of the electrical grid. Because there is no electrical path through the isolation transformer, electricity cannot leave the ERH field. Resistance by the subsurface environment to this flow of electrical current heats the soil and groundwater between the electrodes. Because electrically conductive intervals can be installed to different depth intervals, and the application of energy to the different parts of the electrode field can be controlled, it is possible to heat separate subsurface zones either independently or in unison.

The ERH process is automated, with an onsite computer equipped with a modem and appropriate software for remote access and monitoring. Multiple applications can be monitored and controlled remote from the remediation site or sites, connected via modem. Periodic site visits are required for inspection of the system, maintenance of mechanical equipment, monitoring, manual adjustments to the electrode configurations, and troubleshooting equipment malfunctions.

The only additive normally required for ERH is a drip source of potable water that is applied to soil immediately surrounding the operational electrodes. This water addition,

normally incorporated in low permeability environments, prevents the soil adjacent to the electrodes from drying out and becoming nonconductive. Particular attention is paid to maintaining a net extraction of water from the site over the life of the project.

As the subsurface is resistively heated, contaminants are volatilized and soil moisture and groundwater are converted to steam. The production of steam during ERH operations effectively provides for the in situ steam stripping of VOC contaminants from the soil matrix. By raising subsurface temperatures above the boiling point of the mixture of targeted contaminants and groundwater, ERH significantly enhances the speed and effectiveness of physical contaminant removal. ERH provides the physical conditions that result in the chemical, physical, and biological reactions for their removal from the subsurface.

The rate of steam formation during ERH is very slow, typically requiring approximately 2 to 8 weeks to reach the boiling point, depending on site conditions. Once boiling does begin, it is a very gentle process, comparable to the rate of bubble formation in a glass of carbonated beverage.

The process of in situ steam generation converts groundwater to steam and then vapor recovery removes the steam from the subsurface. This has the same effect as groundwater pumping, with the net result being a slight drawdown of the water table and some measure of hydraulic control. Within the vadose zone, some decrease of soil moisture may occur if the site is covered (preventing rainfall percolation).

2.2.1 In Situ and Aboveground Treatment.

During heating, pore water increases in volume 1700-fold as it is converted to steam. This process results in the creation of fissures in clayey and silty soils, facilitating vapor transport. The steam forms very slowly, so that the formation of fissures is on a very small scale.

Above ground treatment typically involves treating vapors, condensate, and entrained water. Vapor treatment involves reducing the moisture content, typically through conventional "knock-out" pot arrangements and heat exchangers, followed by appropriate treatment (e.g., granular activated carbon, combustion, thermal oxidation, etc.) prior to permitted atmospheric discharge. Treatment of condensate and entrained water involves liquid phase granular activated carbon and/or air stripping through a cooling tower. The cooling tower is analogous to an air stripper, with the vapor fed to the vapor stream treatment equipment. The condensate and entrained water makes multiple passes through the cooling tower, significantly reducing concentrations of volatile constituents. The treated water is then disposed as appropriate for the site (e.g., returned to the subsurface as drip water, offsite treatment and disposal, discharge to the local POTW, NPDESpermitted discharge, etc.).

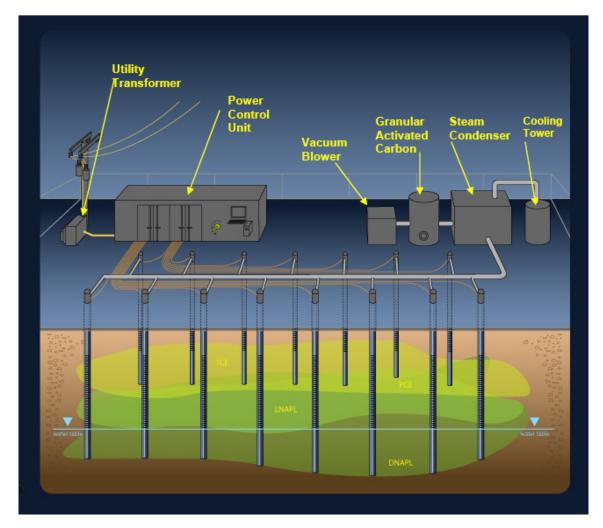


Figure 1: Conceptual Depiction of the Application of ERH

2.2 Any available information on relationship or current understanding between energy delivery and heating rates (i.e. efficiency of energy conversion to heat)

The relationship between energy input and temperature is not straightforward, for there are many factors that influence temperature, including the shape of the volume of the soil and groundwater that is being heated, heat losses (that are influenced by the geometry of the treatment volume), groundwater flow rate, applied vacuum and airflow rates, soil and groundwater electrical conductance, (which changes with temperature), depth of treatment beneath the water table, and other operational issues. Other operational issues relating to the rate of heating deal with the electrical conductivity of the site, the available electrical power, size and type of the vapor treatment system and the rate at which vapors may be discharged from the treatment system.

Figure 2 presents a graph showing the applied power and resultant average temperature for a confidential site in the Chicago, Illinois area. For this site, power was initially applied at a relatively high level, but was reduced prior to the temperature achieving its maximum of 87.5°C on October 25, 2006. It should be noted that the maximum average temperature achieved was adequate and appropriate for this application and achieved the cleanup goals within the projected timeframe.

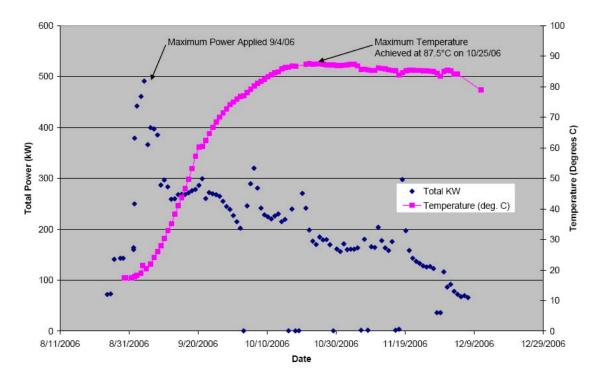


Figure 2: Applied Power (kW) and Temperature

2.3 Limitations of the energy delivery/heating process (i.e. what temperatures can be reached?, how even is the heat/energy distribution?, do natural phenomena limit the heating?)

The maximum temperature achievable is the boiling point of water, which is governed by the atmospheric pressure (i.e., the boiling point increases with depth). Heating increases the total dissolved solids in groundwater, which in turn increases electrical conductivity. The total dissolved solids in groundwater are affected by biogeochemical reactions. For example, zones which may have high chloride from intrinsic biodegradation of chlorinated ethenes heat up rapidly. Heating becomes more even with time, as illustrated in Figure 3.

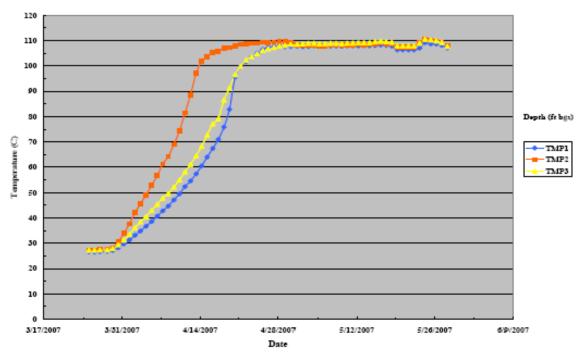


Figure 3: Temperature monitoring showing average temperature versus time at the 3 monitoring locations.

2.4 Unique advantages/disadvantages of this energy delivery/heating approach for contaminant removal or destruction?

Because ERH involves the electrical resistance of the soil matrix to create increases in temperature, there are several inherent features that create advantages for this technology. First, it seeks out the most conductive areas for treatment first. Electrical current, seeking out the path of least resistance will heat areas of high total dissolved solids (TDS) first. Areas of high TDS are the result of biogeochemical reactions associated with the biodegradation of organic compounds, which also corresponds to areas adjacent to high contaminant concentrations. TDS increases throughout ERH, such that electrical conductivity increases as well. TRS' own testing has shown that for chlorinated ethenes and ethanes, chloride represents on the order of 90% of the anions and 40% of all major ions in water during ERH. While different zones heat up quicker, the site is typically heated to a uniform temperature at depth as illustrated in Figure 3, providing for complete treatment throughout.

Second, the technology is self correcting. If some areas heat up in preference to others, the moisture content is reduced, in turn reducing the ability of the soil and groundwater to conduct electricity. The electrical current will seek other pathways until the previously heated area is re-hydrated either naturally or from the ERH drip system.

The electrodes, as noted above, are constructed of readily-available materials (steel pipe, copper plate, sheet pile, etc.) using standard drilling techniques and multiple electrodes

can be constructed within the same borehole to heat selective zones. The deepest heating has been to 100 ft in Paducah, Kentucky.

2.5 *Is the process applied differently if the contaminants are below the water table?*

There is no real difference between applications above and below the water table. The technology requires a minimum of 3% field moisture. The main concern with applications below the water table is groundwater velocity of greater than 1 ft/day, which results in heat losses that need to be controlled. Control can be performed through conventional groundwater control methods (i.e., wells, French drains, sheet pile, slurry walls, freeze walls, etc.).

3.0 Process Configuration Information

3.1 Generic layout of the process showing spacing (heaters, electrodes, wells, temperature, etc.) of in situ components for a "typical" application

Figure 1 presents the conceptual layout for an ERH application. Electrodes are spaced 15 to 23 ft (4.6 to 7 m) apart. The spacing is dependent upon the characteristics of the contaminants to be treated, the desired rate of heating, expected heat losses, the construction of the electrodes that can be achieved, and the desired final temperature to be achieved.

Temperature monitoring points are located throughout the treatment area, and are typically located equidistant between groups of electrodes to monitor temperatures at the furthest distance from the energy application point. Each temperature monitoring point consists of a string of thermocouples, typically set at 5 ft depths.

3.2 Generic layout of above-ground components, showing the footprint of a "typical" application

The layout of the above ground treatment components is dependent upon space available and access. In general, the vapor recovery blower and the condenser are located in a manner to minimize piping from the treatment area, but maintain a safe distance from the area that is being treated. Granular activated carbon vessels and a Baker tank for temporary water storage are typically located in a manner to provide for vehicular access for water removal (if required) and change out of carbon (if required).

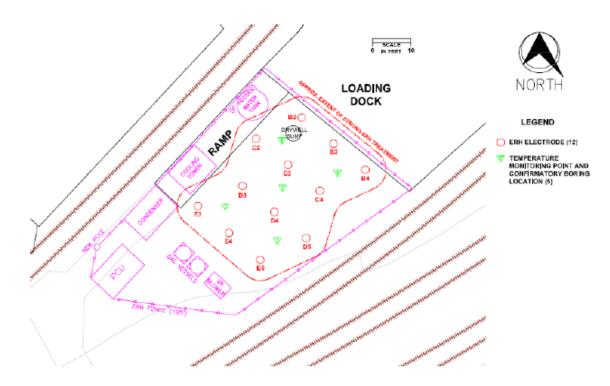


Figure 4: Typical equipment layout for ERH application

3.3 Special utility requirements (power, water, surface cover, security, etc.)

Depending on the equipment needed for a given site, 480 V three-phase or standard 13.8 KV three-phase line voltages are required to power the PCU, which then distributes power to the electrodes and ancillary equipment. A source of potable water is also required during the initial phases of application as a source of drip water and for the cooling tower at start up. Water during operations is normally supplied by the condensate produced from the heating. A data quality telephone line may be necessary for adequate remote communications. Surface covers typically consist of existing pavement or concrete if working in an industrial area. For bare ground applications, the surface may be covered with polyethylene sheeting, depending on depth of treatment depth below grade. The sheeting is used to maintain vacuum and minimize the surface infiltration from precipitation.

The level of security depends on the location where the ERH treatment is being performed. Historically, most locations have involved working in or around active and shuttered factories, where standard chain-link fencing and placarding indicating the electrical hazards has been appropriate. The next level of security that is typically used involves perimeter electronic monitoring to provide alarmed automatic shut down of the system to prevent potential electrical shock to intruders. When the perimeter system is tripped, the operator is notified and the system is restarted once the operator has confirmed that operations can safely continue. TRS has not had to impose a higher level of security, but if needed, this is envisaged as involving a perimeter electronic system

with periodic to continuous manual security checks provided by a contract security company.

3.4 Is the process configured differently if the contaminants are below the water table?

As noted above under Section 2.5, there is no real difference between applications above and below the water table and as such there is no difference in the configuration.

4.0 Process Information

4.1 Typical monitoring/diagnostics for the technology during operation (i.e. how do you know it's working?)

Monitoring during ERH involves tracking temperature, power and energy application, and organic vapor concentrations. It has been observed that most of the organic vapors are produced during the heat-up portion of operations. When organic vapor concentrations decrease by approximately 80% from peak concentrations, electrical resistance heating typically is temporarily stopped and interim groundwater or soil sampling is performed. The analytical results are then evaluated to determine if and where additional treatment is required. Power application to individual electrodes may be ceased in order to focus treatment in select areas, thus reducing cost. Natural attenuation processes (most importantly intrinsic biodegradation) are also commonly assessed at this time to determine if remediation goals can be attained under post-thermal treatment conditions. Based upon the results of interim sampling, heating can be continued or post-remedial sampling can be conducted to document that the remedial action objectives for soil and groundwater have been met.

4.2 Post-treatment issues (time period needed for cooling/access/etc.)

After ERH treatment, soil and groundwater typically return to ambient temperatures within 6 to 24 months. During this cool down period, groundwater and soil sampling may be safely conducted using the proper precautions. TRS has developed protocols for sampling that have been approved by federal and state environmental protection agencies. Safe access to the site is normally restored within two days to two weeks of cessation of power application.

5.0 Technology Selection

5.1 For what scenarios is the technology ideally suited?

ERH has been most widely applied for the remediation of chlorinated ethenes and ethanes where DNAPL is present, since these groups of chemicals represent the most commonly encountered environmental contaminants, with the exception of fuels. There have been a small number of sites contaminated with fuels that have been remediated

using ERH. ERH has also been used to hydrolyze a few pesticide impacted sites, and is now seeing some application for MGP site and creosote sites.

5.2 *Under what conditions is the technology "challenged"?*

As noted above, the technology may be challenged in instances where heat losses through high groundwater flow may represent an issue. These conditions can usually be mitigated using engineered solutions.

ERH has been used in buildings where there has been sufficient overhead clearance from which to install the electrodes. This is generally site specific, depending upon the overhead clearance and available drilling equipment with which to install the electrodes. Electrodes drilled at an angle have been successfully installed and used at a number of sites to access difficult areas.

Some PAH compounds may represent a challenge. Generally, significant reduction in concentration (>85%) has been observed for compounds with boiling points of less than 300°C. PAH compounds, with boiling temperatures of greater than 300°C tend to adhere to the soils and are not significantly reduced, but are not considered mobile in groundwater environments.

Concerns over geotechnical stability are dealt with relatively easily and have not represented a problem. ERH does not pose a threat to underground foundations and utilities.

Steam Enhanced Extraction By Gorm Heron (TerraTherm) and Gregory Crisp (TerraTherm)

1. Overview of Technology

1.1 *One paragraph description of the state of the thermal application*

Steam Enhanced Extraction (SEE) has been used successfully for treatment of large sites, and numerous pilot tests have shown great promise for applications to a variety of contaminants, including chlorinated solvents, oil, and creosote. Two large sites have been closed, achieving MCL level groundwater concentrations after effective source removal.

1.2 New improvements to the technology over the past 5 years

The technology was significantly expanded and adapted during the period of 1998-2003 with focus on optimizing steam delivery and heating completeness, use of pressure cycling to enhance removal, and applications in moderately permeable strata and fractured rock. New combinations with thermal conduction heating are promising adaptations for heterogeneous sites, and are currently being implemented.

2. Energy Delivery/Heating Information

2.1 Basic conceptual overview of the energy delivery/soil heating process (i.e. a conceptual drawing showing the basic components and a simple conceptual time-series of energy transfer/heating in the subsurface)

SEE involves installation of a network of injection and extraction wells, installation of temperature monitoring equipment, injection of steam into the wells, and extraction of hot fluids for on-site separation and treatment¹². The injection of steam is a stable and predictable process, since the steam propagation is governed by heat transfer to the formation, which has been studied intensively for oil recovery. This predictability allows for hydraulic control of non-aqueous phase liquid (NAPL) mobility, as steam sweeps from the outside in and pushes NAPL and vaporized contaminants of concern (COCs) towards the central parts of the site for extraction.

The steam displaces subsurface fluids such as water, NAPL, and air and creates a steam zone with reduced liquid saturations. During the steam front propagation, the target zone is heated both by the steam itself, and by the warm/hot condensate migrating with it. The condensate is formed when some of the steam condenses after being cooled by the subsurface materials.

After the target zone for steam injection has been heated, a steam zone is created between the injection and extraction wells. A period of pressure cycling is induced by varying the injection pressure and rates, as well as the applied vacuum. This pressure cycling has

¹² Davis, E.L. (1998): Steam injection for soil and aquifer remediation. US EPA Issue paper EPA/540/S-97/505.

been demonstrated to improve removal rates for COCs dramatically, and to achieve very low concentrations in the original source zone.

Figure 1 shows a generic sketch of an SEE site.

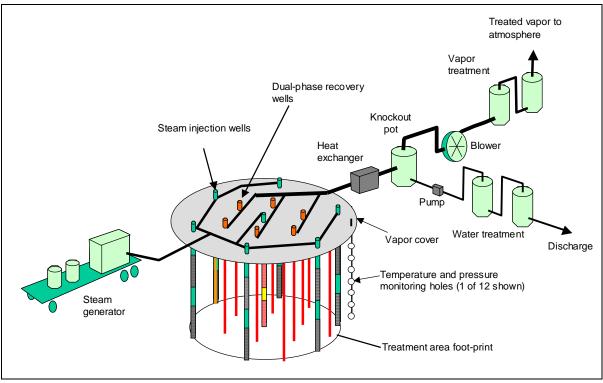


Figure 1. Conceptual Sketch of Steam Enhanced Extraction System.

A more detailed sketch of a steam generating process is shown on Figure 2. Note that the water supply is fresh water, and that the fuel can be either natural gas, propane, or diesel. Some steam generators or boilers have a pre-heating step (de-airator), where the feed water is heated using some of the produced steam.

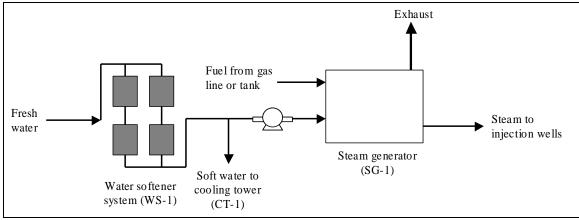


Figure 2. Steam generation system schematic.

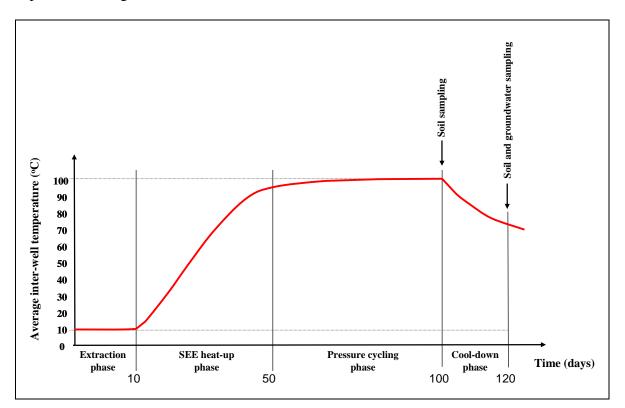
For treatment of a separate NAPL source area, the treatment zone is typically surrounded by steam injection wells installed in clean material. The extraction wells are located in high-concentration areas, each surrounded by four or six steam injection wells.

A typical site has the following components:

- Transformer to supply 480 V, 3-phase power.
- Vertically installed injection wells installed with grout and sandpack.
- Groundwater and vapor recovery wells (horizontal or vertical, or both, depending on geology).
- Temperature and pressure monitoring wells.
- A water softening and steam generation system.
- An air compressor or blower to deliver air for co-injection with steam (if used).
- An off-gas and water treatment system with varying components depending on contaminants and expected mass loading.

Air co-injection is sometimes used to minimize the risk of forming condensation banks containing NAPL, and to enhance the vapor transport to extraction wells¹³.

A typical operational period, using treatment to the boiling point of water as an example is provided in Figure 3.



¹³ Kaslusky and Udell 2002. A theoretical model of air and steam co-injection to prevent the downward migration of DNAPLs during Steam-Enhanced Extraction. Journal of Contaminant Hydrology, 55: 213-232.

_

Figure 3. Typical timeline for operation of an SEE system.

The extraction phase is used to document pneumatic control and to demonstrate that the effluent treatment system meets the regulatory demands for contaminant removal efficiency. This period is also used to document hydraulic control and sufficient water treatment.

During the heat-up phase, steam is injected into each well at a pre-determined rate (based on target zone thickness, permeability, and well spacing), and the ground heats up due to the convection of heated fluids such as steam, air, and water. The goal of this phase is to heat the target volume to steam temperature and to allow for steam break-through to the extraction wells. During this period cool groundwater is being displaced to extraction wells, and a steam zone develops until steam sweeps through to the extraction wells. This period is also called the "steam sweep".

The pressure cycling phase is a period where steam is generated in-situ, and steam stripping is used to lower contaminant concentrations to below target levels. It often overlaps with heating of the bottom-most depths, and/or areas that lag behind the average heating, to the target temperature. Details of the pressure cycling principle was published by Udell 1996¹⁴. Heron et al. (2003) used pressure cycling to achieve MCL level groundwater concentrations at the Young-Rainey STAR Center Area A site¹⁵.

Interim and final confirmatory soil sampling (and groundwater sampling, where required) is used to assess the treatment efficacy. Once the data comes back from the laboratory and shows that the objectives are met, a short cool-down period follows, where steam is removed from the subsurface and the site is cooled to an acceptable final temperature. Then, the SEE equipment and the well-field are decommissioned.

2.2 Any available information on relationship or current understanding between energy delivery and heating rates (i.e. efficiency of energy conversion to heat)

The hydrogeology controls the rate of steam injection at each site. Typically, the steam is pushed through the formation for steam breakthrough to extraction wells in less than 60 days. This is desirable to (1) limit the operations time at the site and (2) minimize the risk of steam over-ride, where the buoyancy of the steam makes it flow on top of groundwater and/or NAPL, reducing the sweep efficiency. For larger sites, the steam sweep may be staged across the site, such that the operational period is longer than that of each segment being heated with steam. This means that large sites have longer durations.

The following pressure cycle duration depends on the remediation goals. More stringent goals means longer pressure cycling. Typically, between 1 month (for small VOC sites) to a year or longer (for large crossote sites) are used.

-

¹⁴ Udell, K.S. 1996. Heat and mass transfer in clean-up of underground toxic wastes. In Annual Reviews of Heat Transfer, Vol. 7, Chang-Lin Tien, Ed.; Begell House, Inc.: New York, Wallingford, UK, pp. 333-405.

¹⁵ Heron, G., Carroll, S., and Nielsen, S.G.D., 2005. Full-Scale Removal of DNAPL Constituents using steam enhanced extraction and electrical resistance heating. Ground Water Monitoring and Remediation, 25(4): 92-107.

Finally, the cool-down period depends on site size and objectives, but typically last between 1 week and several months.

Typical total durations are shown in table 1.

Table 1. Typical duration of SEE operation as a function of well spacing.

Steam injection	Operational duration for	Example site
well spacing (ft)	source zones (days)	
<20	50-100	Alameda Point Site 5 ¹⁶
20-40	100-200	Young-Rainey STAR Center Area
		A^{17}
>40	200-400+	Visalia Pole Yard (Creosote) ¹⁸

Actual durations are site-specific, and depend on factors such as:

- Initial saturation (the wetter the longer it takes).
- Porosity (the higher the longer it takes).
- Water table position.
- Groundwater seepage velocity and recharge (if a hydraulic barrier is not used).
- Mineral composition (minor differences between common minerals).
- Initial contaminant mass.
- Target contaminant concentration (the lower the longer it takes).
- Target contaminant boiling point and volatility (higher boiling point compounds require longer operation).

If the project schedule is critical, the well spacing is chosen for a given site to match the available time.

Several tools exist for predicting/estimating the steam zone progression and time for the steam to migrate to the extraction wells. These range from simple rule-of-thumb relations to sophisticated 3-dimensional non-isothermal simulators such as T2VOC, TOUGH2, and STARS.

2.3 Limitations of the energy delivery/heating process (i.e. what temperatures can be reached?, how even is the heat/energy distribution?, do natural phenomena limit the heating?)

The largest limitation of SEE is soil permeability. Many sites are too tight to allow steam to be injected and heat the target volume sufficiently. It is typically not considered safe to inject at steam pressure above 0.5 psig per ft of overburden located over the injection

_

¹⁶ Udell et al. 2000. BERC (2000). Steam Enhanced Extraction Demonstration at Site 5, Alameda Point. Field Feasibility Demonstration for the US Navy, DO-9. Berkeley Environmental Restoration Center, University of California at Berkeley.Berkeley, CA. Final report.

¹⁷ Heron et al. 2005. Ibid.

 $^{^{\}rm 18}$ Eaker, Craig 2007. Southern California Edison, Rosemead, CA. Personal communication.

screen. Higher pressures can lead to lifting of the formation and surface escape of steam. Example sites where insufficient steam injection rates are achievable are ones dominated by thick clay zones and competent bedrock sites with minimal fracturing. Each site must be carefully evaluated to determine whether SEE technology is the right choice for delivering the energy to the target volume.

For compounds with boiling points above 200°C, steam stripping and vaporization are not effective mechanisms, and technologies that can reach higher temperatures may be more applicable. SEE may only be capable of removing the mobile NAPL and reduce concentrations by steam distillation, which affects the lighter end of the NAPL (lowest molecular weight compounds in the mix).

For SVOCs such as PAH and creosote, SEE has been shown to be effective in long-term applications such as the Visalia Pole Yard¹⁹, where SEE was followed by a period of enhanced natural attenuation. Field data from other sites also indicate that SEE can remove the bulk of the DNAPL mass in a relatively short period, if the subsurface hydrogeology allows for steam sweep of the DNAPL zones. However, such sites typically are not completely depleted in the organic contaminants, since steam stripping is less effective for the higher molecular weight contaminants such as benz(a)pyrene.

2.4 Unique advantages/disadvantages of this energy delivery/heating approach for contaminant removal or destruction?

Steam is by far the cheapest form of energy for injection. Typical boiler efficiencies in the range of 80 to 90% means that ~ 85% of the fuel value in the fuel is injected. For comparison the electricity using in ERH and TCH/ISTD applications is generated at power plants with much lower energy conversion efficiency, plus line losses for delivery. In addition, cold water is displaced by the advancing steam, such that it does not require energy for heating. The result is that the same block of earth can be heated using approximately half the fossil fuel of an electrical heating process, and costing about half. For large sites the savings may be the difference between a project being over or under the acceptable budget.

Steam injection and extraction wells are very simple and inexpensive to construct. Injection wells are 1, 2, or 4-inch diameter carbon steel pipes with a stainless steel screen, set in sandpacks and sealed using high-temperature grout. The borehole size does not increase as the wells need to go deeper.

A potential disadvantage is the inability to heat tight zones, where the steam cannot be injected at a sufficient rate. Another potential disadvantage is the steam buoyancy in deep or thick formations, where steam rise may lead to bypassing of DNAPL layers pooled at the base of an aquifer. A good and detailed analysis of the site hydrogeology is key to managing these potential disadvantages.

¹⁹ Eaker 2007. Ibid.

Relatively new heating combinations are designed to minimize the disadvantages of steam (by combining it with TCH) and optimizing the use of the lower-energy heating method (by enhancing electrical heating projects using steam injection).

2.5 *Is the process applied differently if the contaminants are below the water table?*

In principle, no. The steam wells are installed and operated in the same manner. However, for vadose zone applications, recovery of the condensate generated when steam cools in the formation is essential. This condensate can be rich in contaminants, particularly early on in the operational period. Thus, hydraulic control must be ensured.

Below the water table the steam behavior is well-described from decades of enhanced oil recovery, and SEE is an applicable technology.

Most SEE sites to date have treated both a saturated zone and a vadose zone simultaneously. This facilitates easy hydraulic control by pumping, and pneumatic control by vacuum extraction above the water table.

3. Process Configuration Information

3.1 Generic lay-out of the process showing spacings (heaters, electrodes, wells, etc.) of in situ components for a "typical" application

Steam injection and extraction wells are typically located either in a square pattern (5-spot) or in a triangular pattern (7-spot) as shown on Figure 4. However, the pattern does not have to be regular, since this is a fluid-delivery based process without electrical phasing considerations.

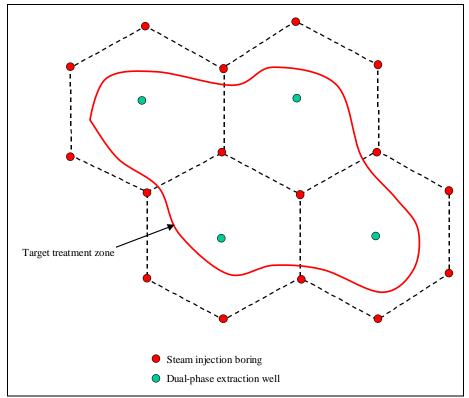


Figure 4. Generic layout of heater borings and process equipment for an SEE project.

The spacing between steam wells is discussed in Section 1.2. Well spacings have ranged from 20 ft at relatively low-permeability sites to more than 50 ft at sites with high hydraulic conductivity and significant depth.

Vapor and water extraction wells can either be vertical wells within the pattern (heated or unheated), or horizontal or angled wells located in optimized positions to capture the heated fluids. Figure 5 shows the wells in a schematic cross-section. The extraction wells are fully screened, allowing for NAPL and water recovery also when the operations lead to partial dewatering and large changes in the depth of the water table. Steam injection wells are typically screened at the base of the treatment zone, or slightly deeper to allow for steam rise into the target treatment zone.

Note that several sites have been heated using more than one steam injection well interval per location. Several projects have used three injection intervals, as for example EarthTech and SteamTech.²⁰

²⁰ Earth Tech and SteamTech (2003): Site 61 Treatability Study Report, Steam Injection. Northwest Main Base, Operable Unit 8. Draft report submitted to US Air Force Flight Test Center, Environmental Restoration Division, Edwards AFB, California.

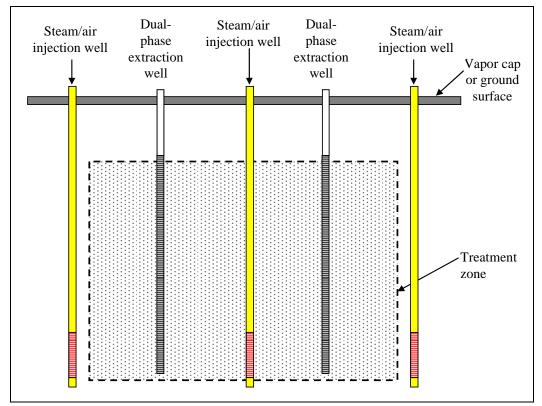


Figure 5. Generic cross-section for an SEE site with one injection interval.

Each site is analyzed in detail, and both the steam delivery and the vapor and water recovery wells and extraction approach is determined based on site-specific conditions.

A vapor cover is typically used when treating to shallow depths. The cover serves three purposes:

- 4. It provides thermal insulation and prevents contaminants from condensing near the land surface, which will occur if the soil is cool.
- 5. It prevents rainwater infiltration, which could lead to unwanted cooling of the treatment zone.
- 6. It provides a vapor seal and increases the radius of influence of the vapor extraction screens.

Temperature and pressure monitoring wells are simple vertical borings used to document performance and pneumatic control during treatment. These are located inside and outside the treatment area, typically at different distances from the operational wells to illustrate the progression of the SEE process in the subsurface.

3.2 Generic lay-out of above-ground components, showing the footprint of a "typical" application

The above-ground equipment varies from site to site depending on treatment area size, volume, nature of contamination, and local regulatory requirements for treating the effluents.

The steam generation system was described in Section 2.1.

A typical extraction and treatment system is shown in Figure 6. Typically, effluent fluids are condensed before vapor treatment, and that conventional vapor and water treatment technologies are acceptable. The heat exchanger/condenser reduces the temperature of the extracted vapors, to remove steam and increase the efficiency of the water and vapor treatment. The fluids then are separated into liquids and vapors in a liquid-vapor separator. The vapor treatment system is assumed to consist of a granular activated carbon (GAC) system, and a vacuum blower. Other vapor treatment options include Catalytic or Thermal Oxidation. Condensate treatment is by liquid phase GAC filtration (sometimes preceded or replaced by air stripping).

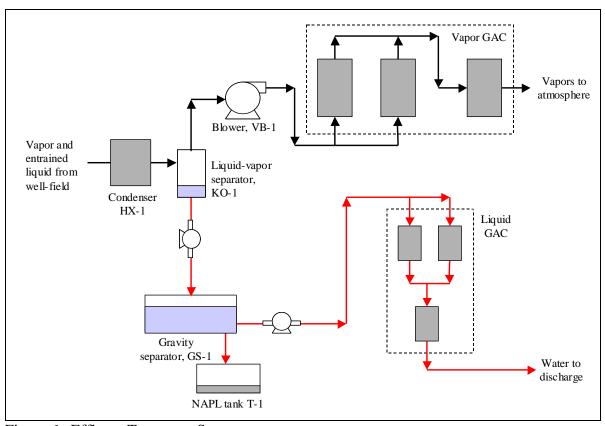


Figure 6. Effluent Treatment System.

Since the extracted fluids include water, potentially NAPL, air, and steam at varying temperatures and pressures, the treatment system is a robust combination of cooling, separation and treatment units previously proven to be effective for their functions.

For sites with large contaminant mass loading, the vapor treatment is often done using thermal oxidation or other methods capable of handling the high recovery rates.

The surface layout is dictated by site-specific conditions such as the location of utility connections, obstructions such as buildings, and an effort to minimize the piping runs from the well field area to the treatment process. For small sites, the treatment system is placed on a trailer or in a container, and mobilized to the site as one unit. For sites requiring large treatment components, individual process equipment units may be mobilized and connected at the site.

3.3 Special utility requirements (power, water, surface cover, security, etc.)

The required utilities are:

- Power (480 V, 3-phase).
- Water (for drilling, cleaning, office trailer, steam generation, and sometimes for the process if using a cooling tower or wet acid gas scrubbing).
- Gas or diesel when fuel is used for steam generation and sometimes for off-gas treatment (such as an oxidizer) or for generating power as a back-up.
- Telephone and internet for communications and process controls.

At some sites, plant steam is used, which reduces the demand for water and fuel.

3.4 Is the process configured differently if the contaminants are below the water table?

No, SEE is well suited for both vadose zone and saturated zone treatment. Condensate collection is important for vadose zone applications, since some of the injected steam condensed and must be extracted. The process equipment is very similar whether the SEE is applied above or below the water table. Vapor and liquid extraction is important in all cases.

4. Process Information

4.1 Typical durations of applications, and how does one decide to turn it off?

For VOC sites, typical durations are between 2 and 6 months, depending on site-specific requirements and the chosen well spacing.

For SVOC sites, typical durations are between 6 months and 1 year. Some sites have taken longer, when coupled with enhanced natural attenuation, or when a very large volume is treated in stages.

Performance is typically based on soil concentrations, since soil can be readily sampled during operation, using methods identical or similar to those tested and documented by Gaberell et al.²¹. The criteria for turning off the system are typically the same as the

-

²¹ Gaberell, M., A. Gavaskar, E. Drescher, J. Sminchak, L. Cumming, W-S. Yoon, and S. De Silva. 2002. Soil Core Characterization Strategy at DNAPL Sites Subjected to Strong Thermal or Chemical

criteria for successful remediation – the system is operated until the client has regulatory approval that the remedy is complete.

Sampling of soil eliminates a classical problem – groundwater rebound occurring after the treatment. By sampling the phase from where rebound would originate (by desorption and diffusion out of bypassed solids), the risk of post-remediation contaminant concentration increases is minimized/eliminated.

For some sites without specific numeric cleanup standards, other parameters are used to determine when to cease operation:

- Groundwater concentrations (although these are hard to use due to the complex chemistry at elevated temperatures and difficulty in collection of representative samples without loss of the contaminants). Groundwater samples can potentially show you more impressive remediation results due to the low solubility of most VOCs in hot water near the boiling point. Basing the decision to stop treatment on such samples may be risky and rebound could occur during cool-down.
- Target treatment temperature. This would be applied to the coolest locations within the target treatment zone and used to focus the heating process towards the end of the operational period.
- Energy balance calculation showing steam stripping and generation of an
 exchange of a certain amount of steam (typically related to the pore volume of the
 treatment zone). The amount of steam flushing and pressure cycling needed can
 be estimated based on laboratory testing, and depends on initial concentrations
 and the specific remediation goals.
- Diminishing recovery of contaminants while ensuring that the heating process and fluid extraction process are operated according to specifications. This can be risky, since diminishing returns can be reached without treatment of the entire targeted volume, as documented as an interim result at the Young-Rainey STAR project²², where the discovery of a cool area led to focused heating and more complete remediation after the vapor recovery had dropped to low levels temporarily.

Site-specific performance goals are negotiated and typically made part of the contract for the SEE project. They typically tie directly into the regulatory demands for site closure or remedy acceptance, such that the client and the SEE contractor work towards the same objective.

4.2 Typical monitoring/diagnostics for the technology during operation (i.e. how do you know it's working?)

Remediation. Paper 1E-07, in: A.R. Gavaskar and A.S.C. Chen (Eds.), *Remediation of Chlorinated and Recalcitrant Compounds*—2002.

ER-0314 38 Appendix B

²² Heron, G., Carroll, S., and Nielsen, S.G.D., 2005. Full-Scale Removal of DNAPL Constituents using steam enhanced extraction and electrical resistance heating. Ground Water Monitoring and Remediation, 25(4): 92-107.

The monitoring is based on:

- Hydraulic control (documented using groundwater elevation monitoring).
- Pneumatic control (documented using pressure monitoring).
- Subsurface temperatures (documented using thermocouples, fiberoptic sensors or similar temperature monitoring equipment).
- Contaminant removal rates and totals (estimated by sampling the effluent vapor, water, and NAPL). The totals are compared to initial mass estimates, considering the typical uncertainties of such estimates. However, the total mass recovered is never used to determine when to cease operation, due to the uncertainties in initial mass estimates.
- Vapor treatment efficacy (based on vapor samples before and after the treatment unit).
- Water/condensate treatment efficacy (based on water samples before and after the treatment unit).
- Energy balance calculations.
- Interim sampling of soil and/or groundwater within and around the treatment zone (showing reductions in contaminant concentrations compared to original levels).
 These samples are typically the most important for determining when to cease operation.
- Final confirmatory sampling.

In addition, site-specific monitoring related to health and safety and community monitoring may be conducted.

4.3 Post-treatment issues (time period needed for cooling/access/etc.)

This is site-specific and depends on future site use. Typically, live steam is removed from the subsurface over a period of 1 to 2 weeks, while the site starts the cool-down. At some sites, cold water is injected to assist with cooling. When demobilization begins, the subsurface temperatures may be as high as 90°C. Removal of the surface cover enhances the cooling. Demobilization is typically complete between 1 and 2 months after completing the remediation.

5. Technology Selection

5.1 For what scenarios is the technology ideally suited?

Generally, SEE is favored by the following conditions:

- Recalcitrant contaminants not easily addressed by Monitored Natural Attenuation (MNA), Soil Vapor Extraction (SVE), or pump and treat. The most suited contaminants would include most CVOCs, DNAPL, and creosote.
- Large contaminant mass and concentrations, with significant NAPL presence, such as large fuel spills with substantial LNAPL accumulation on a water table (so less aggressive, cheaper methods are ineffective).
- Sites with a driver to clean within a relatively short time-frame (where long-term solutions suffer due to insecurity about when they can be shut off).
- Sites deeper than 10 ft (the wells can readily be extended deeper without much additional cost).
- Sites where excavation is unpractical or expensive (so SEE can compete on a unit cost basis).

SEE is potentially partially suited for fractured rock sites. To date, three pilot test demonstrations have been conducted, with varying degree of success. Highly weathered and fractured rock sites with significant mass above the water table are the most promising candidate sites for SEE in rock.

5.2 *Under what conditions is the technology "challenged"?*

The following conditions challenge the applicability of SEE:

- Very shallow and wide-spread contamination. For such sites, heat losses may become prohibitive due to the large surface area, and the injection rates are limited by the weight of the overburden, restricting injection pressures to 5 psig or less.
- Contamination present under structures where vertical drilling is prohibited. SEE
 can readily be done using angled or horizontal borings, but the complexity and
 cost of the drilling and installation increases significantly compared to vertical
 installations.
- Sites dominated by low-permeability materials such as clay, fine silt, or competent bedrock with sparse fracturing. Intrinsic permeabilities below 0.1 darcy, equivalent to a hydraulic conductivity of 10⁻⁴ cm/sec, is considered the lower range for SEE applications. For sites with tighter zones, combinations with ERH or TCH may be applicable.
- Sites with a very stringent numerical cleanup standard for soil and groundwater and a heterogeneous geology. Generally, it is difficult to predict the exact steam migration paths and heating pattern, and thus also the final COC concentrations when using SEE than when using TCH, since the fluid-based delivery is more

sensitive to heterogeneity and permeability contrasts that TCH which relies on thermal conduction.

Typical concerns about geotechnical stability and damage to foundations, buildings, or underground utilities are dealt with relatively easily on a site-specific basis, and have not been a significant barrier to SEE implementation.

Hot Air/Steam Injection Thermal Remediation Using Large Diameter Auger (LDA) In-Situ Soil Mixing

by

Phil La Mori and Elgin Kirkland, FECC Corporation

1. Overview of Technology

1.1 One paragraph description of the state of the thermal application

Thermal treatment of contaminated soils and groundwater by in-situ soil mixing using large diameter augers (LDA) while injecting hot air and steam is an effective way to remove source zone volatile organic compounds (VOCs), semi-volatile organic compounds (SVOC) and petroleum hydrocarbons (TPHC) contamination. The technology operates one treatment cell at a time by advancing a single 6' to 10' auger to depths of over 70'.²³ During active mixing the permeability increases, permitting the soil and groundwater to be treated evenly by the injected high-pressure hot air and steam. Steam heats the contaminated soil and groundwater to a temperature of approximately 75 degrees Celsius, thermally desorbing the VOCs and volatilizing the non-adsorbed VOCs, while the air carries the volatilized off-gas contamination to the surface for capture and treatment. The process, which appears to follow pseudo first-order kinetics, is very effective in removing a large percentage of VOCs during the early treatment stages, but requires extended treatment times to further increase the percentage of removal, i.e. there is a diminishing return for thermal treatment versus cost. Typically the in-situ thermal technology removes 90 % to 97 % of the VOC and 50% to 90% of the SVOC.

1.2 New improvements to the technology over the past 5 years

The major improvement to the technology over the last 5 years has been the development of the combined thermal remediation followed by injection of zero valent iron (ZVI) powder in a water/guar slurry for remediation of chlorinated DNAPL source zones. The ZVI continues the remediation after the thermal treatment has stopped. This approach takes advantage of the strengths of both treatment technologies: for thermal treatment this is the effective removal of large amounts of contamination early on and the mixing, distribution and dissolution of the DNAPL that allows the iron to continue remediation of the chlorinated VOC long after the drilling unit has been removed. Removal efficiencies of over 99% are routinely achieved at significant cost savings when compared to thermal treatment alone.

2. Energy Delivery/Heating Information

2.1- Basic conceptual overview of the energy delivery/soil heating process (i.e. a conceptual drawing showing the basic components and a simple conceptual time-series of energy transfer/heating in the subsurface)

²³ Dual 5' to 7' diameter augers are also used.

The technology consists of three main units; 1) the track mounted crane with the drill unit and hot air, steam and reagent injection unit, 2) an off gas capture and process and treatment system, and 3) a Data Acquisition System (DAS) and a process control system. These components are configured to meet site-specific conditions and vary depending on the site conditions, characterization and cleanup requirements.

The drill platform, which contains the drilling system and air, steam and reagent dispensing systems, is attached to a track mounted crane that moves around the site on mats. The drill platform turns the drill bar, called the Kelly, that has one end attached to single bladed auger, 6' to 10' feet in diameter, that is capable of penetrating the ground surface to depths in excess of 70'. The top end of the Kelly is attached to the crane and provides the pathway for the air, steam and reagent injection. From there the treatment agents travel down a pipe inside the Kelly and are injected into the soil by ports along the trailing edges of the two bladed auger. Thermal treatment is achieved by injection of hot air and steam. Steam, which is generated by boilers with adequate total capacity, e.g. of 20,000 lb/hr at 335 F, provides the energy to volatilize VOC and SVOC. Hot air, which is channeled to the surface along an annular space created by the rotating drill Kelly, entrains the volatilized VOC and SVOC and TPHC and transfers them to the surface where the off gas is captured and treated. The ZVI slurry which is mixed in batches up to 600 gallons is injected into the soil through the same ports as the steam and air, either separately or with the steam and air. Figure 1 provides a conceptual overview of the thermal treatment operation and equipment.

The off gas capture system consists of a steel can (shroud) placed on the surface covering the drilling area. The diameter of the shroud is approximately 1.5 times the diameter of the auger to insure complete capture of the off gas. The hot off gas (100 F to 185 F) is removed from the shroud and is passed through a gas conditioning unit by a blower operating from 750 to 1200 CFM. The gas conditioning unit cools the gas to 90 F to 100 F and removes the water vapor and dirt particles before being sent to a contaminant destruction unit such as a catalytic oxidizer, flameless thermal oxidizer or thermal oxidizer. Carbon absorption beds are used as emergency backup should the oxidizer unit need to be shutdown for any reason. For small sites with lower concentration of contamination the direct use of the carbon bed is more efficient and costs less than the oxidizer.

The Data Acquisition system (DAS) and process control system are located in an operations and control trailer unit. This unit contains readouts of instrumentation to monitor and control selected key operational parameters. All the instruments also have inline display for field operational use. Also located in the unit are the flame ionization detector(s) (FID) to continuously monitor the concentration of total hydrocarbons and the gas chromatograph(s) (GC) that provides periodic data on the identification of the specific compounds in the off gas stream. The output of the FID, GC, temperature sensors, depth gage and other key instruments are stored in a computerized logging system operated at a pre-selected recording interval, e.g. 1 to 30 seconds. The measured parameters are displayed in tabular form on a monitor screen while selected key parameters are displayed as a function of time on a second monitor screen. Table 1 provides a list of the measured and displayed operational parameters. A typical display of the key operational parameters is shown in Figure 2.

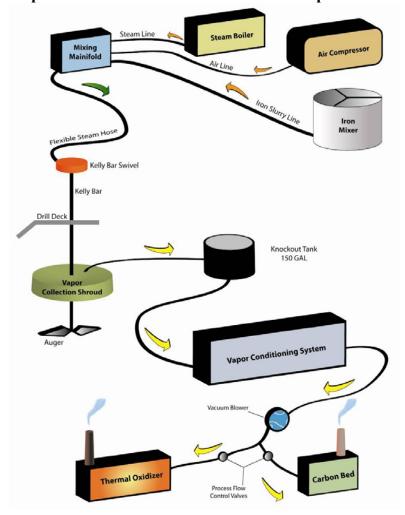


Figure 1. Conceptual overview of the thermal treatment operation and equipment.

Table 1. List of Measured and Displayed Operational Parameters

Operational Location	Parameters Measured	Key Parameters Displayed for Operation & Control
Auger Drill	Depth	Depth
Steam Production	Flow rate, temperature, pressure	Flow rate
Air Compressor	Flow rate, temperature, pressure	Flow rate
Off Gas Conditioning Unit	Flow rate, temperature, pressure, off gas composition by FID and GC	Flow rate, temperature, pressure, off gas composition by FID and GC
Off Gas Shroud	Flow rate, temperature, vacuum	Flow rate, temperature, vacuum
Iron Slurry Mixer	Flow rate	Flow rate
Downhole Condition	Temperature	-

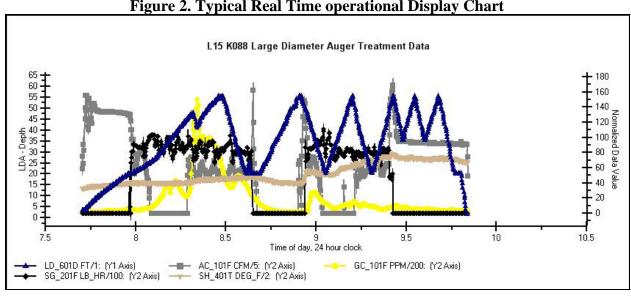


Figure 2. Typical Real Time operational Display Chart

The measured parameters are uploaded in real time to a remote location that stores, analyzes and retrieves the data. The operational data can be accessed in real time over the internet by remotely located technical staff that can then interface with the field operator and take part in the operational decisions.

2.2 -Any available information on relationship or current understanding between energy delivery and heating rates (i.e. efficiency of energy conversion to heat)

The main thermal input, i.e. energy delivery, is accomplished by steam generated from boilers as the hot air provides less than 5% of the heating. The subsurface target temperature is about 170 F (76 C). This temperature is high enough to increase the vapor pressure of most VOC enough to insure high removal rates. In many cases 170 F is greater than their boiling point or exceeds the boiling point of a mixture of the VOC and water. Heating a column of soil to this temperature usually occurs in less than 1 hour.

A typical sandy soil (located for example in Florida) has a mass of 100 lb/ft3 and contains about 30% porosity. Thus, a saturated cubic foot of this soil contains about 18.8 lb of water and 81.2 lb of sand. Since water has a heat capacity of 1 BTU/lb/°F and the sand has a heat capacity of about 0.25 BTU/lb/°F the heat capacity of the soil is about 0.391 BTU/lb/°F. Assuming that the column of soil to be heated is 30' thick and the auger is 8' in diameter, i.e. has an area of 50.27 ft2, the mass of soil to be heated is 50 ft2 x 30 ft x 100 lb/ft3 = 150,000 lb. The energy to heat the soil from an ambient 70 F to 170 F is approximately 5,850,000 BTU. This calculation indicates that it will take approximately 30 minutes to heat the soil using heat input of 12,000,000 BTU/hr.

This calculation and analysis implies an initial drilling penetration rate of about 1 ft/min. This rate is often difficult to achieve during the initial penetration of the auger for the reason that during the initial penetration the ground is hard and compacted. Drilling rates of 0.5 ft/min or less are often encountered during the initial pass. When these conditions occur the heating rate is lowered to control the process.

2.3 - Limitations of the energy delivery/heating process (i.e. what temperatures can be reached, how even is the heat/energy distribution, and do natural phenomena limit the heating?)

The limitation on energy delivery caused by ground conditions and drilling rates was noted above.

There are 3 other controlling factors for the thermal input, the boiling point of water with depth, the stability of the subsurface operation to handle the steam/air flow and the cooling capacity of the off gas process treating system. The soil/groundwater can be heated to a maximum temperature of the boiling point of water at depth. In practice the operational temperature limitation is about 70 C to 80 C (158 F to 176 F) in the shroud with somewhat higher temperatures in the subsurface. This surface temperature limitation is the result of the fact that the off gas reaching the surface is saturated with water vapor and this vapor must be removed from the off gas stream before it enters the thermal oxidizer and/or activated carbon beds. Above 80 C the vapor pressure increases rapidly and the heat rejection requirement of the off gas cooling unit increases quickly and the cost becomes prohibitive. Figure 3 shows the temperature/vapor pressure curve of water.

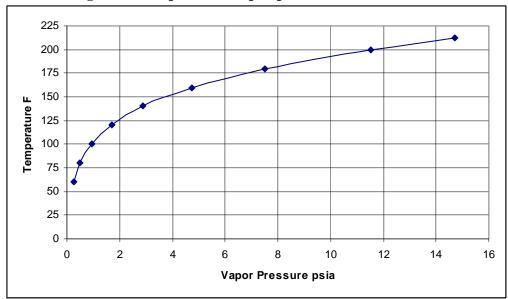


Figure 3. Temperature/vapor pressure curve of water.

Also, the subsurface stability of the operation becomes critical at higher temperatures. When the off gas temperature exceeds about 60 C in the shroud and the downhole temperature is above 70 C the annular pathway to the surface starts to collapse and open in a pulsating manner causing pressure burping and over pressuring the shroud. This can result in raising the shroud and the release of contaminated vapors into the atmosphere and work area as well as injecting steam directly into the process system. The steam is injected into the process system because the

²⁴ Post treatment temperature surveys show that the temperature at depth approaches the boiling point of water. Downhole temperature surveys taken during treatment also indicated that the soil temperature at depth approaches the boiling point curve.

subsurface temperature will be close to the boiling point and when the annular column reopens the first vapors to release are at the atmospheric boiling point and are saturated with steam. This problem is fairly easily controlled by diligently managing the air and steam flow.

2.4 - Unique advantages/disadvantages of this energy delivery/heating approach for contaminant removal or destruction

Some of the advantages of this technology are:

- The below ground mixing provides active remediation and assures that treatment agents contact all the contamination.
- The Data Acquisition System, including the FID and GC, for process monitoring, feed-back and control, allow operational decisions to be made real time and allow the remediation to be focused on the depths where there is contamination.
- Immediate removal and capture and/or destruction of the contamination occurs through the off gas treatment system.
- The use of the FID and GC when combined with the off gas flow permits calculation of the amount of each species removed.
- The technology provides the capability to combine the thermal treatment with other treatment processes in a single operation to achieve more complete removal and faster closure at lower cost.
- The technology operates equally well in vadose and saturated zones to 70'-100' below ground surface.

Another advantage of the technology arises from the fact that water and Cl⁻ VOCs are highly insoluble. The insoluble mixture forms a minimum boiling point azeotrope that is concentrated with the organic compound(s). The lower boiling point and azeotrope properties are believed to improve the thermal removal efficiency of the technology. The following table lists two azeotropes of interest.

Table 2. Data for two Important Azeotropes.

Components	Boiling	Azeotrope	Composition	Upper	Lower
	Point	BP° C.	Azeotrope wt.	Layer	Layer
	(BP)° C.		%	wt. %	wt. %
Water	100		6.30	99.8	0.02
TCE	87.10	73.1	93.7	0.2	99.98
Water	100		17.2	99.98	0.01
PCE	121.0	88.5	82.8	.02	99.99

Other innovative aspects of the technology application include measurement and/or control of all key process parameters including downhole temperature, auger depth and real time measurement of off-gas contaminant concentration using both flame ionization detector (FID) and gas chromatograph (GC). The FID/GC allow profiling the concentration of contamination vs. depth, providing field personnel real time data to make decisions such as focusing the interval of treatment on depths showing higher contaminated levels until the removal objectives have been met. This is shown in the enclosed chart, Figure 4 where the FID increases at 17' depth with peaks at 20', 40' and 52'. This chart shows 4 thermal treatment passes from 15' to 57' plus 1 iron treatment pass (a pass is defined as full movement in both directions).

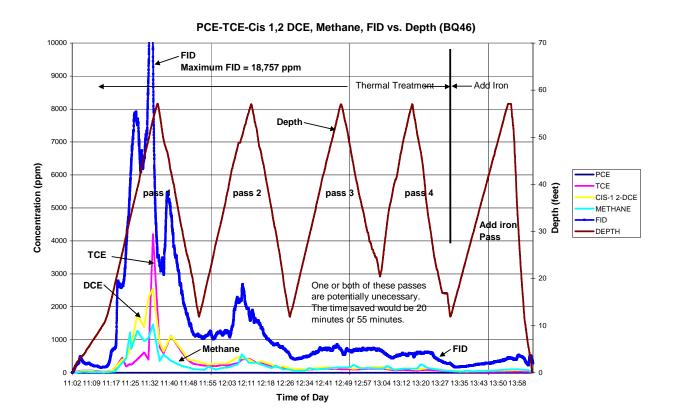


Figure 4. Typical Display of Key Operational Parameters.

One disadvantage of the technology is the long time required to achieve very high removal efficiencies with the thermal treatment. This is the result of an observed pseudo first order thermal removal rate; i.e. high removal early in the treatment but much lower removal later in the treatment. The actual contaminant removal is believed to be more complex than pseudo first order and is probably made up of air stripping, volatilization and desorption components. The air stripping and volatilization components are believed to dominate the early removal while the desorption component is much slower and dominates the later remediation. Combining the high early thermal removal with the addition of a second treatment agent has resulted in very high total contaminant removal at a reduced cost. The addition of ZVI for removal of chlorinated VOC has been very effective. The addition of an inorganic oxidizer has been proposed for petroleum hydrocarbons.

Another disadvantage of the technology is the temperature limitations of the boiling point of water and of about 80 C in the shroud. This problem was discussed above. The effect of the azeotrope formation mitigates this to some extent. Experience has shown however that the thermal remediation of semi-volatile organic compounds (SVC) is less efficient than for VOC, e.g. 60% versus over 90%.

2.5 - Is the process applied differently if the contaminants are below the water table?

The LDA Thermal treatment technology has been applied separately in the vadose zone and saturated zone as well as in both zones in one treatment cell. There appears to be no obvious difference in the application to either zone. Calculation of the energy required to heat vadose zone soils is about ¾ of the energy to heat saturated soils. This does not present a problem because the boiler output easily supplies this difference and, as stated above, the initial drilling into the ground is often slowed so that the steam input is cut back to prevent over heating.

3. Process Configuration Information

Generic layout of the process showing spacing (heaters, electrodes, wells, temperature, etc.) of in situ components for a "typical" application

The technology operates as a batch process with each cell being remediated separately. Once the cell is remediated to pre-selected criteria the drill is removed from the cell and setup over the next cell. Figure 5 shows how the cells are laid out and overlapped to insure 100% areal coverage with dimensions for a 7 foot diameter auger. Figure 5 also shows the cross section of the Kelly with its welded angle brackets that create the annulus as the auger rotates. This cross section also shows the 3" diameter stainless steel injection pipe.

Annulus

Angle Brackets

Annulus

Annulus

Annulus

Annulus

Annulus

Annulus

Hollow

Kelly Bar

Cross-Section

Hexagon Area = (6/4) * s² * ctn (π/6)

Figure 5. Typical cell layout surface view and Kelly cross section.

Generic layout of above-ground components, showing the footprint of a "typical" application

A typical layout of the equipment for site remediation is shown in Figure 1.

Special utility requirements (power, water, surface cover, security, etc.)

The utility requirements are nominal. A typical operation will require 500 to 1000 kilowatts of electricity, a maximum of 1500 gallons of water per hour and minimal security. An exclusion zone of about 30 meters is maintained during actual operation for personal H&S. Experience has shown that this size exclusion zone and operation with a shroud vacuum of over 1" water is

adequate to control emissions and insure worker H&S. The equipment operates off of mats, but the site needs to be graded flat and have less than 3 degree slope.

Is the process configured differently if the contaminants are below the water table?

As indicated above there are no special requirements for operation below the water table.

4. Process Information

Typical durations of applications, and how does one decide to turn it off?

The decision to turn off the thermal treatment is typically based upon two factors; 1. off gas temperature in the shroud and/or downhole temperature if that measurement is available and 2. the value of the FID, or GC for a key chemical compound(s) like TCE. The temperature component is used to insure that the downhole soil temperature will provide needed thermal desorption after the treatment is complete. The actual stopping value(s) is a function of the cell contamination as determined by the first pass (i.e. a pass is defined as a descent and an ascent to the cell) maximum FID and GC readings.

The FID and/or GC component is used as an indication to turn off the thermal treatment when the reduction in values indicates that extended treatment time is needed to further increase the percentage of removal, i.e. the point where there is a diminishing return for thermal treatment versus cost. Typically this occurs when there is an 80% to 90% reduction in the maximum value observed during the initial pass into the cell. When this occurs the reduction in FID and/or GC values versus time usually becomes asymptotic.

The following table provides a typical decision tree for determining when to turn off the treatment. This table doesn't include GC criteria but these are often used. For example a GC value of less than 200 ppm TCE might be a criterion for initial FID value between 1000 and 10,000 ppm.

Table 3. Example of LDA Thermal Treatment completion Criteria.

Initial Max FID	Shroud	Final FID*	Comment
	Temperature		
< 400 ppm	No criteria	No criteria	In and out and add
			ZVI
> 400 ppm but	> 150 F	< 250 ppm	Should be 1
<1000 ppm			thermal treatment
			pass
> 1000 ppm but <	> 160 F	90% reduction or	
10,000 ppm		asymptotic	
> 10,000 ppm	> 170 F	> 80% reduction	FID values as high
		and asymptotic	as 1000 ppm to
			2000 ppm are
			acceptable.

^{*} Measured methane is excluded

After the thermal treatment is complete, a second treatment agent, e.g. ZVI, can be injected to provide additional long term remediation for the desorbing contamination. Figure 4 illustrates how this decision process might work. After 2 complete passes it is clear that the FID as well as the GC values for TCE and DCE had been reduced to over 90% of their initial maximum and that the decrease in values was approaching asymptotic. However the shroud temperature had not yet reached the target temperature of 170 F. Two additional passes were made to heat the cell before iron was added and the treatment completed.

Although the technology is mature there is limited information available to define the exact values of FID/GC and shroud temperature and when to stop the thermal treatment. A pilot test to determine the decision tree is recommended for most projects. If the pilot test is not included in the budget it can become part of the site treatment for a modest additional cost.

Typical monitoring/diagnostics for the technology during operation (i.e. how do you know it's working?):

The key monitoring points for process operation are the depth of auger, steam flow, air flow, FID, off gas temperature and off gas flow. A GC is useful for determination of the off gas chemistry profile but is not a requirement to determine the functioning of the technology. In fact the technology has often been utilized without a GC. These measurements indicate that the process is functioning as well as providing the key control information to determine when the remediation is completed. These data are measured continuously at a selected time interval, e.g. 10 seconds, and also are displayed in tabular and graphical form to the control operator.

Post-treatment issues (time period needed for cooling/access/etc.):

When the cell treatment is completed there is often a decrease of column length in volume, e.g. ~5%, with the need to add soil to return the site to grade level. This is particularly note worthy in sandy soils. In clay soils there is often an immediate slight increase in volume followed by a slightly greater decrease in volume a day or two later. These volume changes need to be dealt with so that the remediation operation can be completed and also to restore the surface to pretreatment elevations at the completion of the project.

Heating the soils raises their temperature to approximately the boiling point of water as a function of depth. Because most of the sites are relatively thick, e.g. 30' to 50', and cover a wide area the subsurface cools slowly in the absence of cold water influx. Locations where the groundwater flow is measured in inches per day will take from one to two years to cool to their pretreatment temperatures. This presents safety and handing issues for post treatment verification groundwater and soil sampling.

5. Technology Selection

For what scenarios is the technology ideally suited?

This technology is ideally suited for sites where the advantages of soil mixing and rapid treatment are important. These sites come under that category:

- Sites with large concentration and mass of contamination. These sites would probably have significant NAPL presence so that other methods would be less effective or ineffective.
- Sites with uneven or variable lithology where other treatment methods would be confounded by differing permeability and contaminant concentration.
- Sites with mostly VOC or lower boiling point SVOC.
- Sites with target volumes above 3,000 cubic yards. The mobilization cost is an issue for small sites.
- Sites with stringent cleanup standards. The thermal technology when combined with ZVI will treat chlorinated VOC and when combined with an inorganic oxidizer will treat petroleum hydrocarbons, both to ppb levels.
- Sites where there is a need to achieve cleanup in a short period of time, e.g. Brownfields.
- Sites below the water table or in the groundwater.
- Sites where excavation is impractical, i.e. very expensive or difficult because of environmental concerns.
- Shallow sites where the depth is at least 5 feet.
- Sites where focused depth treatment is important.
- Sites with high groundwater flow rates.

Under what conditions is the technology "challenged"?

The technology is challenged by:

- Smaller sites, e.g. less than 2000 cubic yards, due to the high cost of mobilization.
- Sites with low concentrations are more effectively dealt with by other approaches.
- Site with infrastructure, e.g. overhead lines, buildings etc.
- Sites at great depths, e.g. over 100 feet.
- Sites with high boiling point SVOC although oxidization is a potential solution because the mixing capabilities provide excellent treatment.

APPENDIX C

Data Logs

ER-0314 Appendix C

File Analyzed By: PD ____ Date: 11/10/2006 ____Other: Type of treatment: _Conductive ____ Steam Type of Contaminant: _____Pesticides Chlorinated Solvents _ Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: ___ Pilot Test Full Scale System Start of Test: varied End of Test: varied Duration: 42 to 47 days Type of Site: ____Non-DOD DoD Facility Name: Ft. Richardson (Arrays 1,2, and 3) Address: City, State, Zip Code: Ft. Richardson, Alaska OU# or Site #: OU B; Poleline Rd Disposal Area (Arrays 4, 5, and 6) Primary point of contact: Scott Kendell Organization: US Army Corps - Alaska District Address: City, State, Zip Code: Phone #: 907-753-5661 email: scott.kendall@poa02.useace.army.mil Other contacts or vendors who worked on site _ None Point of contact: Vendor, Consultant _____ Vendor, Technical Applications Type: ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0010

General Site Information

___ Hydraulic Conductivity information

Gene	eral Site As	sessment	Data					Facility I	D#: <u>0010</u>
X	Impacted	Zone:	Length (parallel to flow		Width (ft):	<u>87</u> Th	ickness (ft):		Unknown
				as defined by documentation					
				nod for determining size of in	npacted zone (See source z	zone definition attachr	nents)		
			Map attachment	i					
	Monitor V	Valle.	Number of relevant	nonitoring wells with ground	otor doto.				None
<u>x</u>	IVIOTITOT V	veiis.	Number of relevant i	nonitoring wells with ground	Pre-treatment	. 2	Post-treatment:		None
			Number of wells rela	tive to treatment zone:	Fie-tieatilient	. <u>Z</u>	rost-treatment.		
			Pre-treatment	In: 0	Upgradient:	Downgradier	at- Cro	ssgradient:	
			Post-treatment	In: 0	Upgradient:	Downgradier		ssgradient:	
			i ost-treatment	III. <u>U</u>	opgradient.	Downgradier	ii	ssgraulerit.	
<u>x</u>	Soil Boring	as:	Number of relevant so	oil borings with pre-treatmen	t data: 4				
_				oil borings with post-treatmen					
			Number inside treatm			de treatment zone:	<u>4</u>		
				<u>-</u>			=		
<u>x</u>	Types of C	Contamina	ants						
_	**								
							tment Concentration per hemical:		nent Concentration per mical:
		C	hlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/I	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		<u>x</u> Tric	chloroethene	Hexane	Creosote	None	10 mg/kg	None	1 mg/kg
		<u>x</u> Tet	rachloroethene	Jet Fuel		None	1 mg/kg	None	0.1 mg/kg
		1,1-	-dichloroethene	Napthalene		None	None	None	None
		x cis-	-1,2-dichloroethene	Benzene		None	1 mg/kg	None	None
		<u>x</u> tran	ns-1,2-dichloroethene	Tolune		None	0.5 mg/kg	None	None
		1,1-	-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-	-dichloroethane	m/p-xylene		None	None	None	None
Che	emicals of	1,1,	,1-trichloroethane	o-xylene		None	None	None	None
	Concern	<u>x</u> 1,1,	,2-trichloroethane			None	0.1 mg/kg	None	None
		<u>x</u> 1,1,	,2,2-tetrachloroethane	1,1,1,2-		None	100 mg/kg	None	1 mg/kg
		Vin	nyl Chloride	x tetrachloroethane		None	0.1 mg/kg	None	None
		x chlo	oroform			None	0.1 mg/kg	None	None
		x carl	bon tetrachloride			None	0.5 mg/kg	None	None
		x chlo	orobenzene			None	0.05 mg/kg	None	None
				x <u>Benzene</u>		None	0.1 mg/kg	None	None
				x <u>hexachlorobutadiene</u>		None	0.5 mg/kg	None	None
						None	None	None	None
	Comme	nte:							
	Comme	1110.							
					Informat	tion for ARRAY 1			
					inioiniai	and the second			
	Attachmer	nts: _							
		_					<u> </u>		
		_							
									<u> </u>

<u>x</u> Imp	pacted.	Zone:	Impacted zone	as defined by documentation hod for determining size of im					Unknown
<u>x</u> Mo	onitor V	/ells:			vater data:				None
					Pre-treatmen	nt: <u>2</u>	Post-treatment:		
			Number of wells rela	ative to treatment zone:					
			Pre-treatment	In: <u>0</u>	Upgradient:	Downgradient:	Cros	ssgradient:	
			Post-treatment	t In: <u>0</u>	Upgradient:	Downgradient:	Cros	ssgradient:	
<u>x</u> Soi	l Boring	js:	Number of relevant s	oil borings with pre-treatment	data: 2	2			
			Number of relevant s	oil borings with post-treatmen	t data:	2			
							2		
				_			_		
<u>х</u> Тур	oes of C	Contaminar	nts						
- "									
					Creosote			_	
		x Tetr	achloroethene	Jet Fuel		None	1 mg/kg	None	0.1 mg/kg
		1,1-	dichloroethene	Napthalene		None	None	None	None
		x cis-	1,2-dichloroethene	Benzene		None	0.5 mg/kg	None	None
		x trans	s-1,2-dichloroethene	Tolune		None	0.1 mg/kg	None	None
		1,1-	dichloroethane	Ethylbenzene		None	None	None	None
		1,2-	dichloroethane	m/p-xylene		None	None	None	None
Chomic	nole of	1,1,	1-trichloroethane	o-xylene		None	None	None	None
		<u>x</u> 1,1,2	2-trichloroethane			None	0.1 mg/kg	None	None
		<u>x</u> 1,1,2	2,2-tetrachloroethane			None	10 mg/kg	None	0.05 mg/kg
		Vin	yl Chloride	x tetrachloroethane		None	0.05 mg/kg	None	None
		x chlo	roform			None	0.05 mg/kg	None	None
		x carb	on tetrachloride			None	0.1 mg/kg	None	None
		x chlo	robenzene			None	0.05 mg/kg	None	None
				x Benzene		None	0.1 mg/kg	None	None
				x hexachlorobutadiene		None	0.1 mg/kg	None	None
						None		None	None
					<u>Informa</u>	ation for ARRAY 1			
Atta	Pre-treatment 2 Post-treatment								
	Impacted zone as defined by documentation Alternative method for determining size of impacted zone (See source zone definition attachments) Many attachment Many attac								

0010

General Site Assessment Data

<u>x</u>	Impacted .	Zone:		as defined by documentation and for determining size of im		_	eness (ft):	_	Unknown
x	Monitor V	Vells:	Number of relevant n	nonitoring wells with groundv	vater data: Pre-treatment	: <u>2</u>	Post-treatment:		None
			Number of wells related	tive to treatment zone:					
			Pre-treatment	In: <u>0</u>	Upgradient:	Downgradient:	Cro	ssgradient:	
			Post-treatment	In: <u>0</u>	Upgradient:	Downgradient:	Cro	ssgradient:	
x	Soil Boring	gs:		bil borings with pre-treatment bil borings with post-treatment ent zone: $\frac{1}{2}$	it data: 4	e treatment zone:	1		
<u>x</u>	Types of C	ontaminan	ts						
						Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:
_		Chl	orinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		x Trich	loroethene	Hexane	Creosote	None	5 mg/kg	None	5 mg/kg
		x Tetra	chloroethene	Jet Fuel		None	0.5 mg/kg	None	0.5 mg/kg
		1,1-d	ichloroethene	Napthalene		None	None	None	None
		x cis-1.	2-dichloroethene	Benzene		None	0.1 mg/kg	None	None
		x trans-	-1,2-dichloroethene	Tolune		None	0.1 mg/kg	None	None
		1,1-d	ichloroethane	Ethylbenzene		None	None	None	None
		1,2-d	ichloroethane	m/p-xylene		None	None	None	None
١.		1,1,1	-trichloroethane	o-xylene		None	None	None	None
1	Chemicals of Concern	<u>x</u> 1,1,2	-trichloroethane			None	0.05 mg/kg	None	None
		<u>x</u> 1,1,2	,2-tetrachloroethane	1,1,1,2-		None	10 mg/kg	None	10 mg/kg
		Viny	Chloride	X tetrachloroethane		None	0.05 mg/kg	None	None
		x chlor	oform			None	0.05 mg/kg	None	None
		x carbo	n tetrachloride			None	0.05 mg/kg	None	None
		x chlor	obenzene			None	0.05 mg/kg	None	None
				x Benzene		None	0.1 mg/kg	None	None
				x <u>hexachlorobutadiene</u>		None	0.1 mg/kg	None	None
						None	None	None	None
	Comme				Informat	ion for ARRAY 1			

0010

General Site Assessment Data

Hyd	rogeologic Conceptual I	Model		Facility ID#: 0010
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses Largely impermeable sediments with inter-bedded layer Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses Largely impermeable sediments with inter-bedded layer Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ted sediments of lower permeability material s of higher permeability material d sediments ted sediments of lower permeability material
<u>x</u>	Ground surface eleva	tion based on wells in o	adjacent to treatment zone: ft amsl	Unknown
<u>x</u>	Aquifer Characteristic		No Yes (number):	_ Unknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	4	
<u>x</u>	Flow direction		<u> </u>	<u> </u>
<u>x</u>	Horizontal hydraulic g Vertical hydraulic grad			<u>X</u> Unknown <u>X</u> Unknown
<u>x</u>	K range (ft/day)	Measured low high	0.05	Field data Unknown
	Transmissivity (ft2/day	y): Measured low	Slug Test Laboratory	Field data

Comments:

The	rmal Treatment - Design							Faci	lity ID#:	<u>0010</u>	
<u>x</u>	Thermal treatment:	Conducti	ve								
		<u>x</u> Electrica	l Resistance	Array 1							
		_	3 phase	<u>x</u>	6 phase		_AC power	•	DC	power	
		Steam									
		_	Steam		_ Steam + air		_ Steam + C	02			
	Towns of Took	Other (de		1.6.							
<u>x</u>	Type of Test:	Pilot test	_	-scale System		میں مام	oonoolidate	ad aadi	imanta		
<u>x</u>	Geology of Treatment Zone				ous and permeatous and imperment						
		<u>x</u>			ediments with int					hility ma	terial
		Δ			sediments with				-	-	
		_			ured bedrock (i.e				go. po	.ouby	a.oa.
					limestone, sand		,				
<u>x</u>	Treatment Targe Zone:	Saturate		Vad		<u>x</u>	Both (Satu	ırated a	nd Vadose	zones)	
<u>x</u>	Start of Thermal Test:	7/11/1997 (en	ded 8/22/97		Duration	: <u>42 d</u>					
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No								
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):			<u>570</u>			Unk	nown	(<u>2</u>	<u>7</u> x	<u>27</u> ft)
	Thickness of target zone (ft	,		<u>27</u>			Unk				
	Depth to top of target zone	, ,		<u>8</u>				nown			
	Thickness of target zone be		e (ft):	<u>25</u>				nown			
	Number of energy delivery	•		<u>6</u>			Unk				
	Number of extraction points	5.		1			Unk	liowii			
<u>x</u>	Temperature Profile:										
	Initial formation temperature	e (deg C):			<u>20</u>				Unknown		
	Maximum representative fo	ormation tempe	rature (deg C	:):	<u>100</u>				Unknown		
	Time to reach maximum re	presentative te	mperature (d	ays):	<u>10</u>				Unknown		
	Duration of treatment at rep	oresentative ter	nperature (da	ays):	<u>32</u>			<u>x</u>	Unknown		
					<u>Da</u>	<u>te</u>		Ī	emperatur	e (deg C	<u>:)</u>
	Formation temperature imn	nediately post-t	reatment:								
	Formation temperature pos	st-treatment mo	nitoring even	nt 1:							_
	Duration of post-treatment	monitoring (day	/s):								_
<u>x</u>	Mass of contaminant remov	ved:									
	Via I	iquid pumping:		7.6		<u>x</u>	lb		kg		Unknow
	In va	apor stream:		3.86	<u> </u>	<u>x</u>	lb		_ kg		Unknow
	Tota	d:		<u>393.</u>	<u>6</u>	<u>x</u>	lb		kg		Unknow
	Comments:										
	Arroy 4 o	f 2									
	Attachments:	<u>" </u>									
	Auduments.										

Ther	mal Treatment - Design									Faci	lity ID#:	<u>0010</u>	
<u>x</u>	Thermal treatment:		Conductive										
		<u>x</u>	Electrical R	tesistance	Array	2							
				3 phase		<u>x</u>	6 phase		_AC powe	er	DC	power	
			Steam	-									
				Steam			Steam + air		_Steam + 0	02			
			Other (desc	ribe)									
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Full-	scale Sy	ystem							
<u>x</u>	Geology of Treatment Zone	e:		Relatively	homog	geneo	us and permea	ble un	consolidat	ed sedi	iments		
				-			us and imperm						
			X				diments with int				•	-	
							sediments with				igher perr	neability	material
			_				ed bedrock (i.e		alline rock	.)			
	Treatment Torre Zone		Caturatad				mestone, sands		D - d - /C - 4		. 137. 1		
X	Treatment Targe Zone: Start of Thermal Test:		Saturated 97 (ended 1	-		vados	Duration:	<u>X</u>		urated a	nd Vadose	zones)	
×	Hydraulic Control	8/24/	Yes	<u></u> No			Duration.	47 u					
<u>x</u>	Tryuraulic Control	^	165	N									
<u>x</u>	Treatment Cell Design:												
_	Size of target zone (ft2):				<u>570</u>				Un	known	(27 x	27 ft)
	Thickness of target zone (ft	t):			27				Un	known			
	Depth to top of target zone	(ft bgs	s):		<u>8</u>				Un	known			
	Thickness of target zone be	elow w	ater table (ft):	<u>25</u>				Un	known			
	Number of energy delivery	points	::		<u>6</u>				Un	known			
	Number of extraction points	S:			1				Un	known			
<u>x</u>	Temperature Profile:												
_	Initial formation temperature	e (deg	ı C):				<u>18</u>				_ Unknowr	1	
	Maximum representative fo			ure (deg C):		100				Unknowr	1	
	Time to reach maximum re	preser	ntative temp	perature (da	ays):		<u>27</u>				Unknowr	1	
	Duration of treatment at rep	oresen	itative temp	erature (da	ys):		<u>20</u>			<u>x</u>	Unknown	1	
	Formation temperature imn	nediat	elv nost-tre	atment.			<u>Dat</u>	<u>e</u>		Ī	emperatu	re (deg C)
	Formation temperature pos				t 1:								
	Duration of post-treatment			ū									
v	Mass of contaminant remov	vod:											
<u>x</u>			oumping:			2.7		<u>x</u>	lb		kσ		Unknown
			tream:			217		<u>×</u>	lb				Unknown
	Tota		irodini.			217 219.7		<u>x</u>	lb		_		Unknown
	. 51.2					21711		-	10		- 16		C.I.I.I.O 11.I.
	Comments:												
	Array 2 o	<u>f 3</u>											
	Attachments:												

Ther	mal Treatment - Design									Faci	lity ID#:	0010	
<u>x</u>	Thermal treatment:		Conductive										
		<u>x</u>	Electrical R	Resistance	Array	e							
				3 phase		<u>x</u>	6 phase		_AC powe	er	DO	power	
			Steam										
				Steam			Steam + air		_Steam +	02			
			Other (desc	ribe)									
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Full-	scale S	ystem							
<u>x</u>	Geology of Treatment Zone	e:		Relatively	homo	geneo	us and permea	ble un	consolidat	ted sedi	iments		
				Relatively	homo	geneo	us and imperm	eable	unconsoli	dated se	ediments		
			<u>X</u>	Largely pe	ermeat	ole sed	diments with int	er-bed	lded lense	s of low	ver perme	ability ma	iterial
							sediments with				igher peri	neability	material
							ed bedrock (i.e		alline rock	.)			
			_				mestone, sands						
<u>X</u>	Treatment Targe Zone:		_ Saturated	-		Vados	-	<u>X</u>		urated a	nd Vadose	zones)	
<u>x</u>	Start of Thermal Test:		97 (ended 1				Duration:	42 d					
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No									
<u>x</u>	Treatment Cell Design:												
	Size of target zone (ft2):				<u>570</u>				Un	known	(<u>27</u> x	<u>27</u> ft)
	Thickness of target zone (ft	:):			<u>27</u>				Un	known			
	Depth to top of target zone	(ft bg:	s):		<u>8</u>				Un	known			
	Thickness of target zone be	elow w	vater table (ft):	<u>25</u>				Un	known			
	Number of energy delivery	points	s:		<u>6</u>				Un	known			
	Number of extraction points	s:			1				Un	known			
v	Temperature Profile:												
<u>x</u>	Initial formation temperature	e (dec	ı C).				<u>8</u>				_ Unknowi	1	
	Maximum representative fo			ure (dea C).		<u>0</u> 100			-	_ Unknowi		
	Time to reach maximum re		-				12				Unknow		
	Duration of treatment at rep		•				30			<u>x</u>	Unknowi		
			,	()	, ,		_			_			
							<u>Dat</u>	<u>e</u>		Ī	emperatu	re (deg C	<u>:)</u>
	Formation temperature imn	nediat	ely post-trea	atment:									
	Formation temperature pos			•	t 1:								_
	Duration of post-treatment	monito	oring (days)	:									
<u>x</u>	Mass of contaminant remov	ved:											
_	Via I	iquid p	pumping:			4.9		<u>x</u>	lb		_ kg		Unknown
	In va	por st	tream:			138		<u>x</u>	lb				Unknown
	Tota	l:				142.9		<u>x</u>	lb		_ kg		Unknown
	Comments:												
	Comments.												
	Array 3 o	f 3											
	Attachments:												

Cost and Performance Facility ID#: 0010 Performance Remediation Goal: In Groundwater: Goals in mg/L: TCE-0.005; 1,1,2,2-tetrachloroethane (PCA)-0.052; PCE-0.005; cis-12-DCE - 0.007; trans-12-DCE - 0.1; benzene - 0.005; carbon tetrachloride - 0.005 In Soil: 1,1,2-trichloroethane - 0.1 mg/kg; PCE - 4.0 mg/kg Was the Remediation Goal Achieved: ____ In Groundwater Comment: __ In Soil Comment: General comments on the thermal application: The application was considered only one application even though the heating of the 3 arrays was ran sequentially. Lessons Learned Energy __ kWhr/yd³ Total Energy Used: ____ kWhr ____ kWhr/m³ kWhr/m³ kWhr/yd³ _ Total energy applied to treatment zone: __ Other energy: kWhr/m³ _ kWhr/yd³ _ Please note other energy: Cost Total Project Cost: 967822 ____ Consultant Cost: __ Thermal Vendor Cost: _ yd³ ___ Energy Cost: 30000 per month ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1:

Other Cost 2:
Other Cost 3:

File Analyzed By: PD ____ Date: 9/18/2006 ____Other: Type of treatment: _Conductive ____ Steam <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _ Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: ___ Pilot Test Full Scale System Start of Test: 7/31/1999 End of Test: 10/4/1999 Duration: 65 DAYS Type of Site: Non-DOD DoD <u>X</u> Facility Name: Ft. Richardson (Arrays 4, 5, and 6) Address: City, State, Zip Code: Ft. Richardson, Alaska OU# or Site #: OU B; Poleline Rd Disposal Area (Arrays 4, 5, and 6) Primary point of contact: Scott Kendell Organization: US Army Corps - Alaska District Address: City, State, Zip Code: Phone #: 907-753-5661 email: scott.kendall@poa02.useace.army.mil Other contacts or vendors who worked on site _ None Point of contact: Vendor, Consultant _____ Vendor, Technical Applications Type: ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC Characteristics of Interest X Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data ___ Good temperature profile vs. time information Flux assessment ___ Groundwater elevations Geologic cross-section

Facility ID#:

0020

General Site Information

___ Hydraulic Conductivity information

Gene	ral Site As	sessment [Data					Facility II	D#: <u>0020</u>
<u>x</u>	Impacted	Zone:	Length (parallel to flow	w direction)(ft.): 225	Width (ft):	<u>87</u> Thi	ckness (ft):	_	Unknown
			Impacted zone a	as defined by documentation					
			Alternative meth	nod for determining size of im	pacted zone (See source zo	one definition attachm	ents)		
			Map attachment	t					
<u>x</u>	Monitor V	Vells:	Number of relevant n	nonitoring wells with ground	vater data:				None
					Pre-treatment:	<u>4</u>	Post-treatment:	<u>4</u>	
			Number of wells related	tive to treatment zone:					
			Pre-treatment	In: <u>4</u>	Upgradient:	Downgradient	:: Cro	ssgradient:	
			Post-treatment	In: 4	Upgradient:	Downgradient	:: Cro	ssgradient:	
				_		· ·		· —	
x	Soil Boring	as:	Number of relevant so	oil borings with pre-treatment	data: <u>6</u>				
_		5 -		oil borings with post-treatmer					
			Number inside treatm			e treatment zone:	1		
			Transor morae treatm	on 2010. <u>2</u>	rtambor datora	o trodunom zono.	±		
<u>x</u>	Types of (Contaminan	nts						
<u>~</u>	. , , , , , , , , , , , , , , , , , , ,								
							ment Concentration per emical:		ent Concentration per nical:
		Chi	lorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)		Groundwater (mg/L)	Soil (mg/kg)
			hloroethene		Creosote		None	0.1 mg/L	None None
			achloroethene	Hexane Jet Fuel	Creosote	1 mg/L 0.01 mg/L	None	0.001 mg/L	None
		F	lichloroethene	Napthalene		None	None	None	
									None
			,2-dichloroethene	X Benzene Tolune		0.001 mg/L	None	0.001 mg/L	None
						0.1 mg/L	None	0.01 mg/L	None
			lichloroethane	Ethylbenzene		None	None	None	None
			lichloroethane	m/p-xylene		None	None	None	None
	micals of		-trichloroethane	o-xylene		None	None	None	None
С	oncern		2-trichloroethane			None	None	None	None
			2,2-tetrachloroethane			10 mg/L	None	0.1 mg/L	None
			l Chloride			None	None	None	None
			on tet			0.01 mg/L	None	0.001 mg/L	None
		x cis-1	,2-dichloroethene			0.1 mg/L	None	0.1 mg/L	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
	Comme	nts:							
					Impacted zone i	s only the source zo	ne.		
	Attachmer	nts:							

Hyd	rogeologic Conceptual	Model				Facility ID#:	0020
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relatively hor Largely imper Competent, b Weathered be Relatively hor Relatively hor Largely imper Competent, b	diments nogeneous and permeable nogeneous and impermeal eable sediments with inter- meable sediments with inter- tut fractured bedrock (i.e. c drock, limestone, sandsto nogeneous and permeable nogeneous and impermeal eable sediments with inter- meable sediments with inter- tut fractured bedrock (i.e. c drock, limestone, sandsto	ble unconsolidated so bedded lenses of low er-bedded layers of h rystalline rock) ne e unconsolidated sed ble unconsolidated so bedded lenses of low er-bedded layers of h rystalline rock)	ediments ver permeability material nigher permeability mater iments ediments ver permeability material	rial
<u>x</u>		tion based on wells in c	or adjacent to treatme	nt zone:	ft amsl	Unknown	
X	Aquifer Characteristic Is more than 1 aquifer		_ No No	Yes (number): Aquifer 2	Unl	known (assume single aqui	fer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	5.5 20	Aquilei 2	Aquilei 3		
<u>x</u>	Flow direction		<u>NE</u>				
<u>x</u>	Horizontal hydraulic g					<u>X</u> Unknown<u>X</u> Unknown	
<u>x</u>	K range (ft/day) Transmissivity (ft2/day)	Measured low high y): Measured low	0.05 0.5	ug TestLabor	atory	Field data Unknown Field data Unknown	
		low high				Unknown	

Comments:

x-section in Tech Report on pages 30-35		

Ther	rmal Treatment - Design							Facility ID#:	0020
<u>x</u>	Thermal treatment:		Conductive						
		<u>x</u> 1	Electrical R	esistance					
				3 phase	<u>x</u>	6 phase	AC power	erD	C power
			Steam						
				Steam		Steam + air	Steam +	O2	
		—	Other (desc	ribe)					
<u>x</u>	Type of Test:	Pilot te	est	Full-	scale System	1			
<u>X</u>	Geology of Treatment Zone	:		Relatively	homogene	ous and permeal	ble unconsolida	ted sediments	
				Relatively	homogene	ous and imperme	eable unconsoli	dated sediments	5
			<u>X</u>			ediments with inte		•	•
									rmeability material
						ired bedrock (i.e.		()	
v	Treetment Torge Zone:					imestone, sands		tunata dan da Mada	
<u>X</u>	Treatment Targe Zone: Start of Thermal Test:	7/31/19		Offig	vauc	ose only Duration:		turated and Vados	se zones)
<u>x</u>	Hydraulic Control		Yes	No		Duration.	03 days		
^	Tryaradilo Comitor	^	103						
<u>x</u>	Treatment Cell Design:								
_	Size of target zone (ft2):				<u>5500</u>		Un	nknown (110 x 50 ft)
	Thickness of target zone (ft):			<u>32</u>		Un	ıknown	
	Depth to top of target zone	(ft bgs)):		<u>8</u>		Un	nknown	
	Thickness of target zone be	elow wa	ater table (ft):	<u>20</u>		Un	nknown	
	Number of energy delivery	points:			<u>21</u>		Un	nknown	
	Number of extraction points	s:			9		Un	nknown	
<u>x</u>	Temperature Profile:								
_	Initial formation temperature	e (deg (C):			<u>10</u>		Unknow	vn
	Maximum representative fo	rmation	n temperat	ure (deg C):	100		Unknov	vn
	Time to reach maximum rep	present	tative temp	erature (da	ays):			<u>x</u> Unknow	vn
	Duration of treatment at rep	resenta	ative temp	erature (da	ıys):			<u>x</u> Unknow	vn
						_		_	
	Formation temperature imm	nediate	ly nost-trea	atment:		<u>Dat</u>	<u>e</u>	<u>I empera</u>	ture (deg C)
	Formation temperature pos				t 1:				
	Duration of post-treatment			_					
v	Mass of contaminant remov	rod:							
<u>x</u>			umping:		29.6		lb	<u>x</u> kg	Unknown
		por str			<u>628</u>		lb	<u>x</u> kg <u>x</u> kg	Unknown
	Tota		cam.		658		lb	x kg	Unknown
	. 5.00				<u>050</u>		1.0	<u>.</u> 5	
	Comments:								
	<u>3 arrays</u>								
	Attachments:								

and Performance						Facility ID#:	0020
Performance							
Remediation Goal:							
	_ In Groundwater: -						
	_						
	In Soil:						
Was the Remediation							
	Comment: -						
	-						
	_ In Soil						
	Comment: -						
	-						
General comments or	n the thermal applica	ation:					
Lessons Learned							
-							
Energy							
Total Energy Used:			1	Whr	_kWhr/m³		kWhr/yd ³
Tota	I energy applied to t	reatment zone:				kWhr/m ³	kWhi
Othe	er energy.						
		_				kWhr/m ³	kWhi
		note other energy:				kWhr/m ³	kWhi
		note other energy:			_	kWhr/m ³	kWhi
_ Cost		note other energy:				. kWhr/m ³	kWhi
Cost Total Project Cost:		note other energy:				kWhr/m ³	kWhi
Total Project Cost:		note other energy:				kWhr/m ³	kWhi
Total Project Cost: Cons	Please	note other energy:				kWhr/m ³	kWhi
Total Project Cost: Cons	Please	note other energy:	onth	m³		, kWhr/m ³	kWhi
Total Project Cost: Cons Ther	Please sultant Cost: mal Vendor Cost:		onth	m³			kWhi
Total Project Cost: Cons Ther Ener Othe	Please sultant Cost: mal Vendor Cost: rgy Cost:		onth	m³			kWhi
Total Project Cost: Cons Ther Ener Othe	Please sultant Cost: mal Vendor Cost: rgy Cost: er Cost 1:		onth_	m³			kWhi
Total Project Cost: Cons Ther Ener Othe	Please sultant Cost: mal Vendor Cost: rgy Cost: er Cost 1: er Cost 2: er Cost 3:		onth	m ³			kWhi

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>x</u> PD						Date:	11/6/2006
	Type of treatment:	Conductive		_ Steam	ERH	<u>x</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	Chlorinated Solv	ents	<u>x</u>	Petroleum Hyd	lrocarbo	ons	Pesticides	
		Wood Treating			Other:				
	Treatment Status:	Active	<u>X</u>	Post					
	Type of Test:	<u>x</u> Pilot Test	_	Full Scale	System				
	Start of Test:	<u>3/26/1998</u>		End	of Test: <u>5/13/199</u>	9		Duration: 413 d	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: Ft. Wainwright								
	Address: <u>CH2M Hil</u>	<u>11</u>							
	City, State, Zip Code:	Ft. Wainright, Alaska							
	OU# or Site #: <u>OU 5</u>								
<u>x</u>	Primary point of contact:	Rich Horn							
	Organization:								
	Address:								_
	City, State, Zip Code:								
	Phone #: 907-646-0287			email: rhor	n@ch2m.com				
	_ Other contacts or vendors wh	ho worked on site			None				
	Point of contact:								
	Type:Vendor, C	onsultant	_Ven	dor, Techni	cal Applications		Otl	ner	_
	Organization:								_
	Address:								
	City, State, Zip Code:								_
	Phone #:			email:					
_	A (O.O.								
Q,	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	atment groundwater data	ı		Good pre	e- and p	ost-treatme	ent soil data	
	Good temperature prof	file vs. time information			Flux asse	essment			
	Groundwater elevation	18			Geologic	cross-s	section		
	Hydraulic Conductivity	y information							

0030

General Site Information

		r \(\(\) (6. \)	140		(6)		
Impacted		w direction)(ft.):as defined by documentation	Width (ft):	Thick	iness (ft):		<u>X</u> Unkn
		as defined by documentation hod for determining size of im		zone definition attachmen	nts)		
	Map attachmen	=		adminion attacillies	,		
Monitor V	Vells: Number of relevant r	monitoring wells with groundy	vater data:				x None
			Pre-treatmen	nt:	Post-treatment:		
	Number of wells rela	tive to treatment zone:					
	Pre-treatment	·	Upgradient:	Downgradient:		ossgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	essgradient:	
Soil Boring	ns: Number of relevant so	oil borings with pre-treatment	data:	<u>5</u>			
	_	oil borings with post-treatmen		<u>0</u>			
	Number inside treatm	- '		ide treatment zone:	<u>0</u>		
Types of C	Contaminants						
				Average Pre-treatme	ent Concentration per	Average Post-treatm	nent Concentra
	CIL : . ICI	B. 1 W. 1	0.1	Cher Groundwater (mg/L)	nical: Soil (mg/kg)	Cher Groundwater (mg/L)	mical: Soil (m
	Chlorinated Solvents Trichloroethene	Petroleum Hydrocarbons Hexane	Other Creosote	None None	None	None None	None None
	Tetrachloroethene	Jet Fuel	Creasure	None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	x Benzene		None	5 mg/kg	None	None
	trans-1,2-dichloroethene	x Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	x 1,2-dichloroethane	m/p-xylene		None	None	None	None
	x 1,2-dichloroethane						
Chamicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern				None None	None 5,000 mg/kg	None None	None None
	1,1,1-trichloroethane	o-xylene					
	1,1,1-trichloroethane 1,1,2-trichloroethane	o-xylene <u>x</u> GRO		None	5,000 mg/kg	None	None
	1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	o-xylene <u>x</u> GRO		None None	5,000 mg/kg 5,000 mg/kg	None None	None None
	1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	o-xylene <u>x</u> GRO		None None	5,000 mg/kg 5,000 mg/kg None	None None None	None None None
	1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	o-xylene <u>x</u> GRO		None None None None None None	5,000 mg/kg 5,000 mg/kg None None None	None None None None None None	None None None None None None
	1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	o-xylene <u>x</u> GRO		None None None None None None None None	5,000 mg/kg 5,000 mg/kg None None None None None None	None None None None None None None	None None None None None None None
	1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	o-xylene <u>x</u> GRO		None None None None None None	5,000 mg/kg 5,000 mg/kg None None None	None None None None None None	None None None None None None

Hydrogeologic Conceptual Model Facility ID#: 0030 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments _ Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _____ft amsl _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): <u>14</u> high value (ft bgs): 19 Unknown: Flow direction NNW Horizontal hydraulic gradient (feet/foot): _ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown K range (ft/day) Measured using: _ Slug Test Field data Laboratory low 400 ____ Unknown high Transmissivity (ft2/day): Measured using: ___ Slug Test ____ Laboratory _ Field data low Unknown

high

Comments:

The	ermal Treatment - Des	ign							Fac	ility ID#:	0030	
<u>x</u>	Thermal treatment:	_	Conductiv	/e								
		_	Electrical	Resistance								
			_	_ 3 phase	_	6 phase		AC	power	DC	power	
		_	Steam									
				Steam	_	Steam + ai	r	Stea	m + O2			
		<u>x</u>	Other (de	scribe)	RFH							
<u>X</u>	Type of Test:	<u>x</u> P	lot test	Full-so	cale Sys	stem						
<u>x</u>	Geology of Treatme	ent Zone:	<u>x</u>	Relatively h	omoge	eneous and pe	rmeab	le unconso	olidated sec	liments		
				_ Relatively h	omoge	eneous and im	perme	able uncor	solidated s	ediments		
				_ Largely per	meable	e sediments wi	th inte	r-bedded le	enses of lov	wer perme	ability m	aterial
				_ Largely imp	ermea	ble sediments	with ir	nter-bedde	d layers of	higher perr	neability	material
						actured bedroo		-	rock)			
				_ Weathered	bedro	ck, limestone,	sandst	one				
<u>X</u>	Treatment Targe Zo	one: _	Saturate	d only		adose only		<u>x</u> Both	(Saturated	and Vadose	zones)	
<u>X</u>	Start of Thermal Te	st: <u>3</u>	26/1998			Dura	ation:	413 day				
	_ Hydraulic Control	_	Yes	No								
<u>x</u>	Treatment Cell Des	ign:										
	Size of target zone	(ft2):		:	400				_ Unknown	(2	<u>20</u> x	<u>20</u> ft)
	Thickness of target	zone (ft):			10				_ Unknown			
	Depth to top of targ	et zone (ft	bgs):		<u>6</u>				_ Unknown			
	Thickness of target	zone belo	w water table	(ft):	0				_ Unknown			
	Number of energy of	delivery po	ints:	:	4				_ Unknown			
	Number of extraction	n points:			1				_ Unknown			
<u>x</u>	Temperature Profile	e:										
	Initial formation tem	perature (deg C):			<u>5</u>				_ Unknown	1	
	Maximum represen	tative form	ation tempera	ature (deg C):		<u>25</u>				_ Unknown	1	
	Time to reach maxi	mum repre	sentative ten	nperature (day	/s):	<u>139</u>				Unknown	ı	
	Duration of treatme	nt at repre	sentative tem	perature (day	s):	<u>274</u>				_ Unknown	1	
							Date	<u> </u>	-	Temperatu	re (deg	<u>C)</u>
	Formation temperat	ture immed	diately post-tr	eatment:								
	Formation temperat	ture post-ti	eatment mor	nitoring event	1:							
	Duration of post-tre	atment mo	nitoring (day	s):								
	_ Mass of contaminar	nt removed	i:									
		Via liqu	id pumping:					lb		_ kg		Unknow
		In vapo	r stream:					lb		_ kg		Unknow
		Total:						lb		_ kg		Unknow
	Comments:											
						20 ft bgs. Mo						of_
		ecuicai pr	odiems thus	neaung only	trie V	adose zone ir	isteac	u oi vados	e and Satt	nated ZON	<u>e.</u>	
	Attachments:											
				-								

Cost and Performance Facility ID#: 0030 Performance Remediation Goal: In Groundwater: DRO -1.5 mg/L: GRO -1.3 mg/L; 1,2-DCA - 0.005 mg/L; Benzene - 0.005 mg/L; Toluene - 1 mg/L; RRO - 1.11 mg/L In Soil: DRO - 200 mg/kg; GRO - 50 mg/kg Was the Remediation Goal Achieved: __ In Groundwater Comment: __ In Soil Comment: General comments on the thermal application: Objective - 1) prevent benzene migration to Chena River and 2) reduce total dissolved hydrocarbons in river Energy numbers only for 351 days of heating and does not include high-temperature kWhr heating period 2 phases of heating: 1) 351 days to get to 15 to 40C and 2) 62 days to get to ? Lessons Learned Energy _ kWhr/yd³ Total Energy Used: ___ kWhr/m³ 55600 kWhr kWhr/yd³ _ Total energy applied to treatment zone: kWhr/m³ _ Other energy: kWhr/m³ _ kWhr/yd³ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: __ Thermal Vendor Cost: ___ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1:

Other Cost 2:
Other Cost 3:

General Site Information Facility ID#: 0040 JT <u>x</u> PD ____ File Analyzed By: Date: 11/6/2006 ____Steam ____Other: Type of treatment: ___ Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ____ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: x Pilot Test Full Scale System Start of Test: End of Test: <u>8/25/1998</u> 3/26/1998 Duration: 155 days Type of Site: ____Non-DOD DoD <u>X</u> Facility Name: Ft. Wainwright Address: CH2M Hill City, State, Zip Code: OU# or Site #: Primary point of contact: Rich Horn Organization: Address: City, State, Zip Code: Phone #: 907-646-0287 email: rhorn@ch2m.com Other contacts or vendors who worked on site ____ None Point of contact: _____ Vendor, Consultant _____ Vendor, Technical Applications Type: ____Other Organization: Address: _ City, State, Zip Code: Phone #: email: ___ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data ____ Good temperature profile vs. time information Flux assessment

____ Geologic cross-section

____ Groundwater elevations

_____ Hydraulic Conductivity information

	nt Data					Facility II	D#: <u>0040</u>
Impacted Zone:	Length (parallel to flo	ow direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u> Unknown
— ·	- "	as defined by documentation					
	Alternative me	thod for determining size of in	npacted zone (See source zo	one definition attachmer	nts)		
	Map attachme	nt					
Monitor Wells:	Number of relevant	monitoring wells with ground	water data:				None
			Pre-treatment:		Post-treatment:	1	
	Number of wells rel	ative to treatment zone:					
	Pre-treatmen	t In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatmen	it In: <u>1</u>	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borings:	Number of relevant	soil borings with pre-treatmen	data: <u>5</u>				
	Number of relevant	soil borings with post-treatment	nt data: <u>6</u>				
	Number inside treatr	ment zone: 5	Number outside	e treatment zone:	<u>6</u>		
Types of Contamin	ants		I			I	
				Average Pre-treatme	ent Concentration per	Average Post-treatm	ent Concentration per
					nical:		nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	richloroethene	Hexane	Creosote	None	None	None	None
	etrachloroethene	Jet Fuel		None	None	None	None
	1-dichloroethene	X Napthalene		None	None	0.01 mg/L	None
	s-1,2-dichloroethene	<u>x</u> Benzene		None	5 mg/kg	0.1 mg/L	0.1 mg/kg
	ans-1,2-dichloroethene	x Tolune		None	None	0.5 mg/L	None
	1-dichloroethane	x Ethylbenzene	-	None	None	0.1 mg/L	None
	2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1-trichloroethane 1,2-trichloroethane	o-xylene		None	None	None	None 500 //
- Concent	1,2-tricnioroetnane 1,2,2-tetrachloroethane	x GRO x DRO		None	1,000 mg/kg 5,000 mg/kg	0.05 mg/L 5 mg/L	500 mg/kg 1,000 mg/kg
V	inyl Chloride	x total xylenes x GRO 10-12		None	None 500 mg/kg	0.05 mg/L None	None 50 mg/kg
		x GRO 15-17		None	1,000 mg/kg	None	500 mg/kg
				INOIIC	1,000 mg/kg	None	Joo mg/kg
				None	1.000 mg/kg	None	500 mg/kg
		<u>x</u> <u>DRO 10-12</u>		None	1,000 mg/kg	None	500 mg/kg
		<u>x</u> <u>DRO 10-12</u> <u>x</u> <u>DRO 15-17</u>		None	5,000 mg/kg	None	5,000 mg/kg
		<u>x</u> <u>DRO 10-12</u>					

Hydrogeologic Conceptual Model Facility ID#: 0040 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) _ Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _____ ft amsl _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): <u>14</u> high value (ft bgs): 19 Unknown: Flow direction NNW Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown K range (ft/day) Measured using: _ Slug Test Field data Laboratory low 400 ____ Unknown high Transmissivity (ft2/day): Measured using: ___ Slug Test ____ Laboratory _ Field data low Unknown high

Comments:

The	rmal Treatment - Design								Facility ID#:	0040	
<u>x</u>	Thermal treatment:		_ Conductive	·							
		<u>x</u>	Electrical F	Resistance							
				3 phase	-	6 phase	_	_ AC powe	er D	OC power	
			_ Steam	Steam		Steam + air		Steam +	O2		
			Other (desc	='	_						
<u>x</u>	Type of Test: <u>x</u>	Pilot	_	Full	-scale Sys	stem					
<u>x</u>	Geology of Treatment Zone	э:	<u>x</u>	·	-	eneous and peri	meable un	consolida	ted sediments		
_	0,		=	-	_	•			dated sediments	6	
				-		·			s of lower perm		aterial
									ers of higher pe	-	
						actured bedrock					
						ck, limestone, sa					
<u>x</u>	Treatment Targe Zone:		Saturated	only	\	adose only	<u>x</u>	Both (Sa	turated and Vado	se zones)	
<u>x</u>	Start of Thermal Test:	3/26	/1998			Durat	tion: <u>155</u>	days			
	_ Hydraulic Control		_ Yes	No							
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):				<u>700</u>			Un	known (<u>30</u> x	30 ft)
	Thickness of target zone (f	t):			<u>13</u>			Un	known		
	Depth to top of target zone	(ft bg	js):		<u>10</u>			Un	known		
	Thickness of target zone be	elow v	water table ((ft):	<u>7</u>			Un	known		
	Number of energy delivery	point	s:		<u>6</u>			Un	known		
	Number of extraction points	s:			1			Un	known		
<u>x</u>	Temperature Profile:										
	Initial formation temperatur	e (de	g C):			<u>5</u>			Unknow	vn	
	Maximum representative for	rmati	on tempera	ture (deg C	C):	<u>90</u>			Unknow	vn	
	Time to reach maximum re	prese	entative temp	perature (d	lays):	<u>118</u>			Unknow	vn	
	Duration of treatment at rep	orese	ntative temp	erature (da	ays):	<u>35</u>			Unknow	vn	
							<u>Date</u>		<u>Tempera</u>	ture (deg C	<u>C)</u>
	Formation temperature imm	nedia	tely post-tre	atment:							
	Formation temperature pos	st-trea	tment moni	toring even	nt 1:						
	Duration of post-treatment	monit	toring (days)):							_
	_ Mass of contaminant remov	ved:									
	Via I	iquid	pumping:					_ lb	kg		Unknow
	In va	apor s	stream:					_ lb	kg		Unknow
	Tota	ıl:						_ lb	kg		Unknow
	Comments:										
	15 ft space	ring									
	Attachments:	<u>Jii iy</u>									
	Auduments.										

Cost and Performance Facility ID#: 0040 Performance Remediation Goal: In Groundwater: DRO -1.5 mg/L: GRO -1.3 mg/L; 1,2-DCA - 0.005 mg/L; Benzene - 0.005 mg/L; Toluene - 1 mg/L; RRO - 1.11 mg/L In Soil: DRO - 200 mg/kg; GRO - 50 mg/kg Was the Remediation Goal Achieved: ____ In Groundwater Comment: __ In Soil Comment: General comments on the thermal application: 2 separate phases of heating: 1) 98 days to heate to between 20 and 40C for 3 months and 2) 57 days to get to 80 to 100C for 1 month Lessons Learned Energy __ kWhr/yd³ Total Energy Used: 205016 ____ kWhr/m³ kWhr __ Total energy applied to treatment zone: kWhr/yd³ __ Other energy: kWhr/m³ _ kWhr/yd³ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: __ Thermal Vendor Cost: ___ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1:

Other Cost 2:
Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u>	PD					Date:	8/24/2007	
	Type of treatment:	<u>x</u>	Conductive		_Steam	ERH	Other:			
	Type of Contaminant:		_ Chlorinated So	lvents		Petroleum Hydrod	carbons	Pesticides		
			Wood Treating			Other:				
	Treatment Status:		Active	<u>x</u>	Post					
	Type of Test:	<u>x</u>	Pilot Test		Full Scale	e System				
	Start of Test:				End	of Test: Aug-07		Duration:		
	Type of Site:	<u>x</u>	Non-DOD		_ DoD					
<u>x</u>	Facility Name: NASA Marshal Space Flight Center									
	Address:								_	
	City, State, Zip Code: Huntsville, AL OU# or Site #:									
<u>x</u>	Primary point of contact:	Ral	ph Baker							
	Organization: TerraTherm, Inc.									
	Address: 10 Stevens Road	<u>l</u>								
	City, State, Zip Code:	Fite	hburg, MA 01420	<u>O</u>						
	Phone #: <u>978-343-0300</u>				email: rbal	ker@terratherm.com				
<u>x</u>	Other contacts or vendors wh	no wo	rked on site			None				
	Point of contact: <u>Jaso</u>	n Col	<u>e</u>							
	Type: X Vendor, C	onsul	tant	Ven	dor, Techni	cal Applications	Oth	ner		
	Organization: <u>CH2M HII</u>	LL, Ir	<u>nc</u>							
	Address: 2035 Lakeside C	Centre	Way; Suite 200_							
	City, State, Zip Code:	Kno	oxville, TN 37922	2						
	Phone #: (865)-560-2987				email: Jaso	on.Cole@ch2m.com				
Q	A/QC									
	_ Characteristics of Interest									
	Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data									
	Good pre- and post-tre	-			Flux assessi	•	Joir duid			
	Groundwater elevation		. ume imormatio			Geologic cr				
	Hydraulic Conductivity		·mation			Geologie el	oss-section			

0043

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0043</u>
Impacted	<u> </u>		Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
		=	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy					None
			Pre-treatment:		Post-treatment:		
		ive to treatment zone:	He are disease	D #1	0		
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin	Number of relevant co	oil borings with pre-treatment	data				
3011 B01111		il borings with post-treatmen					
	Number inside treatme			treatment zone:			
	rumber morae treatme	EIII ZOIIC.	_ rumber outside	iredinent zone.			
Types of 0	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Observiced of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Cor	nto.						
Comme	mis:						
					<u> </u>		
Attachmer	nts:						
	-	·	<u> </u>	<u> </u>	<u> </u>	·	

Hydrogeologic Cor	nceptual Model			Facility ID#:	0043					
Geology:	Zor	<u>ıe</u>	Unconsolidated Sediments							
	Vadose 2	Zone:	Relatively homogeneous and permeable unconsolidated	sediments						
			Relatively homogeneous and impermeable unconsolidate	d sediments						
			Largely permeable sediments with inter-bedded lenses of	lower permeability material						
			Largely impermeable sediments with inter-bedded layers	of higher permeability mater	rial					
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
	Saturated	d Zone:	Relatively homogeneous and permeable unconsolidated sediments							
			Relatively homogeneous and impermeable unconsolidate	d sediments						
			Largely permeable sediments with inter-bedded lenses of lower permeability material							
			Largely impermeable sediments with inter-bedded layers of higher permeability material							
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
Ground surfa	ace elevation based	on wells in o	r adjacent to treatment zone: ft amsl	Unknown						
Aquifer Char	acteristics:									
Is more than	1 aquifer present?		No Yes (number):	Unknown (assume single aquit	fer)					
			Aquifer 1 Aquifer 2 Aquifer 3							
Depth to wat	er: low value	(ft bgs):		_						
	high valu	e (ft bgs):		_						
	Unknown	:		_						
Flow directio	n			_						
Horizontal hy	draulic gradient (fe	et/foot):		Unknown						
Vertical hydra	aulic gradient (feet/f	oot):		Unknown						
K range (ft/da	ay)	Measured	using: Slug Test Laboratory	Field data						
		low		Unknown						
		high		_						
Transmissivi	ty (ft2/day):	Measured	using: Slug Test Laboratory	Field data						
		low		Unknown						
		high		_						
Comments:										
Attachments										

The	rmal Treatment - Design					Facility ID#:	<u>0043</u>
<u>x</u>	Thermal treatment:	x Conductive					
		Electrical Resistance					
		3 phase Steam		_ 6 phase	AC power	DO	C power
		Steam		_ Steam + air	Steam + 0)2	
		Other (describe)					
<u>x</u>	Type of Test: <u>x</u>	· 	ll-scale Syster				
	_Geology of Treatment Zone		-	eous and permeal			
			-	eous and imperme			
				ediments with inte		-	-
							meability material
				ured bedrock (i.e.		1	
			red bedrock,	limestone, sands	tone		
	_Treatment Targe Zone:	Saturated only	Vac	lose only			
	_ Start of Thermal Test:			Duration:			
-	_ Hydraulic Control	Yes No	•				
<u>x</u>	Treatment Cell Design:						
_	Size of target zone (ft2):		<u>858</u>		Unl	known (_ x ft)
	Thickness of target zone (fi	it):	22		Unl	cnown	
	Depth to top of target zone	(ft bgs):	0		Unl	known	
	Thickness of target zone be		<u>-</u> <u>7</u>		<u> </u>	known	
	Number of energy delivery	<u>18</u>		<u> </u>	cnown		
	Number of extraction points				Unl		
<u>x</u>	Temperature Profile:						
	Initial formation temperatur	re (deg C):				Unknow	n
	Maximum representative for	ormation temperature (deg	C):	<u>110</u>		Unknow	n
	Time to reach maximum re	presentative temperature (days):	<u>55</u>		Unknow	n
	Duration of treatment at rep	presentative temperature (d	days):	<u>20</u>		Unknow	n
				Date	9	Temperati	ure (deg C)
	Formation temperature imm	mediately post-treatment:		Date	<u>~</u> 	Temperate	are (deg o)
	Formation temperature pos	st-treatment monitoring eve	ent 1:				
	Duration of post-treatment	monitoring (days):					
	_ Mass of contaminant remove	ved:					
	Via I	liquid pumping:			lb	kg	Unknow
	In va	apor stream:			lb	kg	Unknow
	Tota	al:			lb	kg	Unknow
	Comments:						
	Attachments:						
	Audoninents.						

and Performance					Facility ID#:	0043
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_						
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m³	kWhr/yo
	ner energy:				_ kWhr/m³	kWhr/yo
		note other energy:				күүшүүс
	1 lease	note offici energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
 Th	ermal Vendor Cost:					
	ergy Cost:			m³	_ yd³	
	ner Cost 1:				- / -	
	ner Cost 1:					
	ner Cost 3:					
Oil		Other Cost 1:				
riease note of		Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date: <u>10/29/20</u>
	Type of treatment:	Conductive	<u>X</u>	Steam	ERH Other:	
	Type of Contaminant:	Chlorinated Solve	nts	<u>x</u>	Petroleum Hydrocarbons	Pesticides
		Wood Treating			_ Other:	
	Treatment Status:	Active	<u>X</u>	Post		
	Type of Test:	Pilot Test	<u>X</u>	Full Scale	System	
	Start of Test:			End	of Test:	Duration: 21 months
	Type of Site:	Non-DOD	<u>x</u>	DoD		
<u>x</u>	Facility Name: <u>Defense F</u>	uel Support Point Whittier				
	Address:					
	City, State, Zip Code:	Whittier, AK 99693				
	OU# or Site #:					
<u>x</u>	Primary point of contact:	Wayne Barnum (DESC	Head	dquarters co	ontact) Jack Appolloni (DESC Ala	ska contact)
	Organization: <u>Defense E</u>	nergy Support Center				
	Address: 8725 John J. Kir	ngman Road				
	City, State, Zip Code: HQ (703) 767-83	Fort Belvoir, Virginia 22	2060	<u>-6222</u>		
	Phone #: 4650				.appolloni@dla.mil	
<u>x</u>	Other contacts or vendors wh	no worked on site			None	
	Point of contact: Mich	hael Foster				
	Type: <u>x</u> Vendor, C	onsultant	Vend	dor, Techni	cal ApplicationsC	Other
	Organization: Michael L	. Foster and Associates				
	Address: 13135 Old Glenn	n Highway, Suite 210				
	City, State, Zip Code:	Eagle River, Alaska 995	577			
	Phone #: 907-696-6200			email: mlf	mlfo olocko com	
	 				#IIIId.dldSkd.COIII	
	JQC				gtillid.alaSkd.com	
	J/QC				gillia.alaska.culi	
QA	/QC Characteristics of Interest				guilla.alaska.com	
QA	Characteristics of Interest	atment groundwater data			Good pre- and post-treatn	nent soil data
QA	Characteristics of InterestGood pre- and post-tre					nent soil data
QA	Characteristics of InterestGood pre- and post-tre	eatment groundwater data file vs. time information			Good pre- and post-treatn	nent soil data

0045

General Site Information

General Site	Assessment Data					Facility I	ID#: <u>0045</u>
<u>x</u> Impacte		allel to flow direction)(ft.): 200 ted zone as defined by documentation	Width (ft):	<u>300</u> Thio	ckness (ft): 3	0	Unknown
	 :	ative method for determining size of ir		zone definition attachme	ents)		
	·	ttachment	,		,		
<u>x</u> Monito	r Wells: Number of	relevant monitoring wells with ground	water data:				None
			Pre-treatmen	t: <u>80</u>	Post-treatment:	<u>57</u>	
	Number of	wells relative to treatment zone:					
	Pre-ti	reatment In: 58	Upgradient: 4	Downgradient	: <u>26</u> C	rossgradient: 28	
	Post-t	treatment In: 35	Upgradient: 4	Downgradient	: <u>8</u> C	rossgradient: 23	
Soil Boi	ings: Number of re	elevant soil borings with pre-treatmen	it data:				
	Number of re	elevant soil borings with post-treatme	nt data:				
	Number insi	ide treatment zone:	Number outsi	de treatment zone:			
x Types o	f Contaminants						
					nent Concentration per emical:		nent Concentration per
	Chlorinated Solve	ents Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethe	ene Benzene		None	None	None	None
	trans-1,2-dichloroet	theneTolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals	1,1,1-trichloroethan	ne o-xylene		None	None	None	None
Concern	1,1,2-trichloroethan	ne <u>x JP4</u>		None	None	None	None
	1,1,2,2-tetrachloroe	ethane		None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Com	nents:						
			JP4 estimated	loss of 100,000 gallo	<u>ns</u>		
Attachn	nents:						-

Hydrogeologic Conceptual Model Facility ID#: 0045 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone _ Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): <u>15</u> high value (ft bgs): 30 Unknown: _ Flow direction _ Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: __ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory _ Field data low ____ Unknown high

Comments:

The	rmal Treatment - Design						Facility ID#:	0045	
<u>x</u>	Thermal treatment:	Conducti	ve						
		Electrical	Resistance						
		x Steam	3 phase	6 phase	<u> </u>	_ AC power	DC	power	
		<u>x</u> Steam Other (de	Steam	Steam	+ air	_ Steam + O2			
<u>x</u>	Type of Test:	Pilot test		cale System					
<u>x</u>	Geology of Treatment 2		-	nomogeneous and	l permeable un	consolidated	sediments		
			Relatively I	nomogeneous and	l impermeable	unconsolidat	ed sediments		
		<u>x</u>	Largely permeable sediments with inter-bedded lenses of lower permeability material						
		_	Largely imp	permeable sedime	nts with inter-b	edded layers	of higher per	meability material	
		_	Competent	, but fractured bed	frock (i.e. cryst	alline rock)			
		_	Weathered	bedrock, limestor	ne, sandstone				
	_ Treatment Targe Zone:	: Saturate	d only	Vadose only			nted and Vadose	zones)	
<u>x</u>	Start of Thermal Test:				Ouration: 21 n	nonths			
	_ Hydraulic Control	Yes	No						
	Treatment Call Designs								
-	_ Treatment Cell Design: Size of target zone (ft2)					Unkno	own (1	50 x 150 ft)	
	Thickness of target zon	,				Unkno	` _	<u>00 x 100</u> 1t)	
	Depth to top of target z					Unkno			
	Thickness of target zor			Unkne	own				
	Number of energy deliv			Unkne	own				
	Number of extraction p				Unkno	own			
	_ Temperature Profile:								
	Initial formation temper	rature (deg C):					Unknowi	1	
	Maximum representativ		ature (deg C):	·			Unknow	1	
	Time to reach maximum representative temp			ys):			Unknow	1	
	Duration of treatment a	/s):			Unknow	1			
					<u>Date</u>		Temperatu	re (deg C)	
	Formation temperature			4.					
Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days):									
	Duration of post-treating	ient monitoring (day	3).						
<u>x</u>	Mass of contaminant re	emoved:							
	,	Via liquid pumping:		1000 gal		_ lb	kg	Unknow	
	I	In vapor stream:		15000 gal		_ lb	kg	Unknow	
		Total:		16000 gal		_ lb	kg	Unknow	
	Comments:								
	<u> </u>								
	Attachments:								

Cost	t and Performance					Facility ID#:	<u>0045</u>
	_ Performance						
	Remediation Goal:						
		In Groundwater: -					
		In Soil:					
	Was the Remediation	on Goal Achieved:					
	_	_ In Groundwater _					
		Comment: -					
		_					
		_ In Soil _					
		Comment: -					
		_					
	General comments	on the thermal applica	ation:				
		on the thermal applied					
	-						
	Lessons Learned						
	_ Energy						
	Total Energy Used:			kWhr			Whr/yd ³
	Tot	al energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd³
	Oth	ner energy:				_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
<u>x</u>	Cost						
	Total Project Cost:		<u>3,800,000</u>				
		nsultant Cost:					
		ermal Vendor Cost:					
	En	ergy Cost:			m ³	_ yd³	
	Oth	ner Cost 1:					
	Oth	ner Cost 2:					
	Oth	ner Cost 3:					
	Please note of	her cost:	Other Cost 1:				
			Other Cost 2:				

____ Other Cost 3:

File Analyzed By: <u>X</u> JΤ PD ____ Date: 5/23/2005 Type of treatment: Conductive _Steam ERH Other: Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Pesticides Wood Treating Other: PAH, Dioxins/Furans, PCPs **Treatment Status:** Active Post <u>X</u> Type of Test: __ Pilot Test Full Scale System Start of Test: 2/27/2003 End of Test: 9/24/2005 Duration: 836 d Type of Site: Non-DOD _ DoD Facility Name: Alhambra Pole Yard <u>X</u> Address: City, State, Zip Code: Alhambra CA 91803 OU# or Site #: AOC-2 Primary point of contact: Tony Landler Organization: **SCE** Address: 2244 Walnut Grove Avenue City, State, Zip Code: Rosemead CA 91770 626-302-8692 Phone #: email: tony.landler@sce.com Other contacts or vendors who worked on site None <u>X</u> Point of contact: John Bierschenk Vendor, Consultant __ Vendor, Technical Applications Other Type: Contractor Organization: **TerraTherm** Address: 10 Stevens Road City, State, Zip Code: Fitchburg, MA 01420 Phone #: <u>978-343-0300</u> email: jbierschenk@terratherm.com QA/QC Characteristics of Interest ____ Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data ____ Good temperature profile vs. time information Flux assessment Groundwater elevations Geologic cross-section

Facility ID#:

0060

General Site Information

____ Hydraulic Conductivity information

Ge	neral Site As	sessment [Data						Facility	ID#:	0060
<u>x</u>	Impacted :	Zone:	Length (parallel to flow	v direction)(ft.): <u>bwlow</u>		Width (ft):	Thick	ness (ft):		_	Unknown
			Impacted zone a	as defined by documentation	1						
			Alternative method for determining size of impacted zone (See source zone definition attachments)								
			Map attachment								
<u>x</u>	Monitor V	Vells:	Number of relevant n	nonitoring wells with ground	wate	r data:				<u>x</u>	None
						Pre-treatment:		Post-treatment:			
			Number of wells relat	tive to treatment zone:							
			Pre-treatment	In:	ι	Jpgradient:	Downgradient:	Cro	ssgradient:		
			Post-treatment	In:	ι	Jpgradient:	Downgradient:	Cro	ssgradient:		
<u>x</u>	Soil Boring	gs:	Number of relevant soil borings with pre-treatment data: 65								
			Number of relevant so	oil borings with post-treatme	nt da	ta: <u>23</u>					
			Number inside treatme	ent zone: <u>65/0</u>		Number outside	treatment zone:	23/0			
<u>x</u>	Types of C	Contaminan	ts		_				_		
							Average Pre-treatme	ent Concentration per nical:	Average Post-treatr	nent C	
		Chl	orinated Solvents:	Petroleum Hydrocarbons:		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)
		Trich	loroethene	Hexane	x	Creosote	None	5,000 mg/kg	None		None
		Tetra	chloroethene	Jet Fuel	x	Pentachlorophenol	None	5 mg/kg	None		1 mg/kg
		1,1-d	lichloroethene	Napthalene	x	<u>TPH</u>	None	1,000 mg/kg	None		None
		cis-1	,2-dichloroethene	Benzene	x	benzo(a)pyrene-EQ	None	50 mg/kg	None	-	0.05 mg/kg
		trans	-1,2-dichloroethene	Tolune	x	dioxin*	None	0.01 mg/kg	None		None
		1,1-d	lichloroethane	Ethylbenzene	x	total PAH	None	1,000 mg/kg	None		None
		1,2-d	lichloroethane	m/p-xylene	_		None	None	None		None
1.		1,1,1	-trichloroethane	o-xylene	_		None	None	None		None
10	chemicals of Concern	1,1,2	-trichloroethane		_		None	None	None		None
		1,1,2	,2-tetrachloroethane				None	None	None		None
		Viny	l Chloride		_		None	None	None		None
					_		None	None	None		None
					_		None	None	None		None
							None	None	None		None
					_		None	None	None		None
					_		None	None	None		None
					_		None	None	None		None
		_									
	Comme	nts:									
		ha	_			Volume treated -16	5,200 yd 3 from 7 to 10	05 ft_	*Dioxin as 2,3,7,8	тог	OD TEO and the
		<u>bg:</u>		s actually 0.0001 mg/kg							oost-treatment
		_			_	<u></u>	amples				_
	Attachmer	nts:									
	_										

high

Comments:

Attachments:

Ther	mal Treatment - De	sign				Facility ID#:	<u>0060</u>	
<u>x</u>	Thermal treatment	: <u>x</u> Conductive	Phases 1 & 2					
		Electrical Resista						
		3 pha	ise	_ 6 phase	AC power	DO	C power	
		Steam						
		Steam	n	_Steam + air	Steam + C)2		
		Other (describe)						
<u>x</u>	Type of Test:	Pilot test <u>x</u>	Full-scale System	n				
<u>x</u>	Geology of Treatm	ent Zone: Rela	tively homogene	eous and perme	able unconsolidate	ed sediments		
		Rela	tively homogene	eous and imperr	meable unconsolid	ated sediments		
		Larg	ely permeable s	ediments with ir	nter-bedded lenses	of lower perme	ability material	
		<u>x</u> Larg	ely impermeable	npermeable sediments with inter-bedded layers of higher permeability material				
		Com	petent, but fract	ured bedrock (i.	e. crystalline rock)			
		Wea	thered bedrock,	limestone, sand	dstone			
<u>x</u>	Treatment Targe Z	one: Saturated only	<u>x</u> Vac	lose only	Both (Satu	rated and Vadose	e zones)	
<u>X</u>	Start of Thermal To	est: <u>2/27/2003</u>		Duration	n: <u>836 days</u>			
<u>X</u>	Hydraulic Control	<u>X</u> Yes	_No					
Tota	I Treatment Cell De	sign:						
	Size of target zone	(ft2):	22500		Unk	nown (x ft)	
	Thickness of targe	t zone (ft):	31 (averag	<u>se)</u>	Unk	nown		
	Depth to top of targ	<u>0</u>		Unk	nown			
	Thickness of targe	t zone below water table (ft):	<u>0</u>		Unk	nown		
	Number of energy	delivery points:	<u>785</u>		Unk	nown		
	Number of extracti	on points:	<u>131</u>		Unk	nown		
<u>x</u>	Temperature Profil	e:						
	Initial formation ter					Unknow	n	
	Maximum represer	ntative formation temperature (c	leg C):			Unknow	n	
	Time to reach max	imum representative temperatu	re (days):			Unknow	n	
	Duration of treatme	ent at representative temperatur	re (days):			Unknow	n	
				Da	<u>ate</u>	Temperatu	ire (deg C)	
	Formation tempera	ature immediately post-treatmer	nt:					
	Formation tempera	ature post-treatment monitoring	event 1:					
	Duration of post-tre	eatment monitoring (days):						
<u>x</u>	Mass of contamina	ant removed:						
		Via liquid pumping:			lb	kg	Unknown	
		In vapor stream:	(1) 000 /0 or (2)	3/0//1 05(3)	lb	kg	Unknown	
		Total:	8696		<u>x</u> lb	kg	Unknown	
	Comments: T	reatment was performed in 2	phases Pha	se 1 ended in	early 2004 and n	hase 2 was co	mpleted in	
	<u>S</u>	eptember 2005 7 ft (2.	1 M) spacing v				erage of 31 ft bgs	
		a volume of 12,400 m3 (162 lass Removal Calculation Me		bustion Metho	d (2) MicroFID®	Method (3) CC	2 Method	
	Attachments:	The second secon				, (0, 00		

The	rmal Treatment - Design					Facility ID#:	0060
<u>x</u>	Thermal treatment:	<u>X</u> Conductive<u>Electrical R</u>	·	-			
		Steam	3 phase	6 phase	AC power	DC po	ower
		Other (descr	Steam	Steam + ai	r Steam + C)2	
<u>x</u>	Type of Test: Geology of Treatment Zon	ne:	Relatively ho Relatively ho Largely perm Largely impe Competent, b	mogeneous and im leable sediments wi	rmeable unconsolidate permeable unconsolid the inter-bedded lenses with inter-bedded layer (i.e. crystalline rock) sandstone	ated sediments s of lower permeablers of higher perme	•
<u>x</u>	Treatment Targe Zone:	Saturated	only <u>x</u>	Vadose only	Both (Satu	urated and Vadose zo	ones)
<u>x</u>	Start of Thermal Test:	2/27/03 (ended 2/	(11/04)	Dura	ation: 350 days		
<u>x</u>	Hydraulic Control	X Yes	No		·		
x	Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (Depth to top of target zone by the control of target zone in the control of target zone by the control of target zone in tar	e (ft bgs): pelow water table (f	3 <u>3</u> <u>0</u> ft): <u>0</u>	<u>)4</u>	·	known known known	x ft)
X	Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (deg C) Time to reach maximum representative temperature (deg C) Duration of treatment at representative temperature (deg C)					Unknown Unknown Unknown Unknown	
	Formation temperature im Formation temperature po	st-treatment monito	oring event 1:		<u>Date</u>	<u>Temperature</u>	(deg C)
X		liquid pumping:			lb lb	kg kg kg	Unknown Unknown Unknown
		ended in early 20 gs in a volume of			with depths ranging 419 heater-only wel		
	Attachments:						

Ther	mal Treatment - Design						Facility ID#:	0060		
<u>x</u>	Thermal treatment:	<u>x</u> Cond	ductive Phas	se 2						
		Elec	trical Resistance							
			3 phase	_	6 phase	AC powe	rDC	power		
		Steam	m							
			Steam	_	Steam + air	Steam + 0	02			
		Othe	er (describe)							
<u>x</u>	Type of Test:	Pilot test	<u>x</u> Full	-scale Syst	tem					
<u>x</u>	Geology of Treatment Zone	e:	Relatively	/ homoge	neous and permea	able unconsolidat	ed sediments			
			Relatively	/ homoge	homogeneous and impermeable unconsolidated sediments					
			Largely p	ermeable	sediments with int	ter-bedded lense	s of lower permea	bility material		
			<u>x</u> Largely ir	npermeal	ole sediments with	inter-bedded lay	ers of higher pern	neability material		
			Compete	nt, but fra	ctured bedrock (i.e	e. crystalline rock)			
			· <u></u>	ed bedroc	k, limestone, sand	stone				
<u>x</u>	Treatment Targe Zone:	Satu	urated only	<u>x</u> V	adose only	Both (Sat	urated and Vadose	zones)		
<u>X</u>	Start of Thermal Test:	5/27/04 (e	nded 9/24/05)		Duration	: 486 days				
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No							
<u>x</u>	Treatment Cell Design:									
_	Size of target zone (ft2):			7222		Un	known (_ x ft)		
	Thickness of target zone (f	ft):		28 (aver	rage)	—— Un	known	·		
	Depth to top of target zone			0			known			
		Thickness of target zone below water table (ft):					known			
	Number of energy delivery			<u>0</u> 281		Un				
	Number of extraction point	-		46		Un				
<u>x</u>	Temperature Profile:									
	Initial formation temperatur	re (deg C):			<u>29</u>		Unknown			
	Maximum representative for	ormation ter	mperature (deg C	:):	<u>335</u>		Unknown			
	Time to reach maximum re	epresentativ	e temperature (d	ays):			Unknown			
	Duration of treatment at re	presentative	e temperature (da	ays):			Unknown			
					Da	te	Temperatui	re (deg C)		
	Formation temperature imr	mediately po	ost-treatment:			_				
	Formation temperature pos			nt 1:						
	Duration of post-treatment		-							
			(,-)-		-		-			
<u>x</u>	Mass of contaminant remo	ved:								
	Via	liquid pump	ing:			lb	kg	Unknown		
	In va	apor stream	n:			lb	kg	Unknown		
	Tota	al:				lb	kg	Unknown		
	Comments:									
	Phase 2				ft (2.1 M) spacin	ng with depths ra	anging from 7 to	105 ft with an		
			in a volume of					6 heater-vacuum		
	Attachments:									
	Audumono.									

Performance					
Remediation Goal:					
In	Groundwater: ——				
<u>x</u> In	Soil: 1 PAHs av	rnressed as henzo(a)	nyrene equivalent - 0.06	55 mg/kg; 2. dioxin as 2,3,	7.8 TCDD TEC
	1.1 Alis ex	1 uc	g/kg; 3. pentachlorophe	enol - 2.5 mg/kg	7,0, TODD TEG
Was the Remediation Go					
In					
	Comment: ——				
<u>x</u> In	Soil				
	Comment:				
	<u>Yes</u>				
General comments on the	e thermal application	:			
	••				
Goal was to hit inter	rwell temperature of	635F (335C) for at le	ast 3 days or hit 570F (3	800C) for 30 days No Furt	ther Action lette
issued by Departme	ent of Toxic Substanc	ces Control 2/8/07.	-		
Lessons Learned					
			_		
Energy					
Total Energy Used:	<u>19,359,051</u>		<u>X</u> kWhr	kWhr/m ³ kWh	nr/yd ³
Total en	ergy applied to treatr	nent zone:		kWhr/m ³	kWhr/yd
Other er	nergy:			kWhr/m ³	kWhr/yd
	Please note	other energy:			
Cost					
Total Project Cost:	17,90	00.000.00			
Consulta	ant Cost:	916,000			
Thermal	Vendor Cost:	11,263,000			
Energy (Cost:	2,265,000.00	m ³	yd ³	
Other Co	ost 1:	687,000			
Other Co		600,000			
Other Co		2,169,000			
			Laboratory	d Air Quality Tooting Evans	1000
X Please note other c		Other Cost 1:	· · · · · · · · · · · · · · · · · · ·	d Air Quality Testing Exper	
		Other Cost 2:		SCE Labor Costs oosal, (\$415,000) Regulator	
	(Other Cost 3:	(1,488,000)	Miscellaneous Project Cos	<u>ts</u>

Facility ID#:

0060

Cost and Performance

<u>x</u>	File Analyzed By: JT	<u>x</u> PD			Date:	10/26/2006				
	Type of treatment:	Conductive	Steam	ERH <u>x</u> Other:	<u>RFH</u>					
	Type of Contaminant:	Chlorinated Solv	vents <u>x</u>	Petroleum Hydrocarbons	Pesticides					
		Wood Treating		Other:						
	Treatment Status:	Active	<u>x</u> Post							
	Type of Test:	<u>x</u> Pilot Test	Full Scale	System						
	Start of Test:		End	of Test:	Duration:					
	Type of Site:	<u>x</u> Non-DOD	DoD							
<u>x</u>	Facility Name: <u>Texaco</u> Address:									
	City, State, Zip Code:	Bakersville, CA				_				
	OU# or Site #:									
	B	D 17 11								
<u>X</u>	Primary point of contact:	Ray Kasevich								
	Organization: KSN Ener									
	Address: 291 Main St., 3rd Floor, PO Box 612 City, State, Zip Code: Great Barrington, MA 01230									
	Phone #: 413-528-4651	Oreat Barrington, MA		sevich@ksnenergies.com						
	<u> </u>		<u> </u>	or ren e konenergressesm						
	_ Other contacts or vendors w	ho worked on site		None						
	Point of contact:									
	Type:Vendor, ConsultantVendor, Technical ApplicationsOther									
	Organization:									
	Address:									
	City, State, Zip Code:									
	Phone #:		email:							
Q	A/QC									
	_ Characteristics of Interest	ı								
-	Good pre- and post-tre	eatment groundwater data	a	Good pre- and post-treatme	ent soil data					
	Good temperature prof	file vs. time information		Flux assessment						
	Groundwater elevation	ns		Geologic cross-section						
	Hydraulic Conductivit	y information								

Facility ID#:

0065

General Site As	sessment Data					Facility II	D#: <u>0065</u>	
Impacted	- · · ·		Width (ft):	Thick	ness (ft):		Unknown	
	 :	as defined by documentation						
	· · · · · · · · · · · · · · · · · · ·	=	pacted zone (See source zo	ne definition attachmer	nts)			
	Map attachment							
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy					None	
		Pre-treatment: Post-treatment: Number of wells relative to treatment zone:						
			He are disease	D #1	0			
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:		
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
Soil Boring	no: Number of relevant co	oil borings with pre-treatment	data					
3011 13011119		il borings with post-treatmen						
	Number inside treatme			treatment zone:				
	Number morae deading	Ent Zono.	_ rumber outside	iredinent zone.				
Types of 0	Contaminants							
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None	None	None	None	
	Tetrachloroethene	Jet Fuel		None	None	None	None	
	1,1-dichloroethene	Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	Benzene		None	None	None	None	
	trans-1,2-dichloroethene	Tolune		None	None	None	None	
	1,1-dichloroethane	Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	m/p-xylene		None	None	None	None	
Observiced of	1,1,1-trichloroethane	o-xylene		None	None	None	None	
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
Cor	nto.							
Comme	mis:							
					<u> </u>			
Attachmer	nts:							
	-	·	<u> </u>	<u> </u>	<u> </u>	·		

Hydrogeologic Conceptua	Il Model		Facility ID#: 0065
Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated se Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated se Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	diments sediments over permeability material higher permeability material diments sediments over permeability material
Ground surface elev		adjacent to treatment zone: ft amsl	Unknown
Is more than 1 aquif		No Yes (number): U	nknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3	- - -
Flow direction			_
Horizontal hydraulic Vertical hydraulic gr			Unknown
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
Transmissivity (ft2/d	low high ay): Measured low high	using: Slug Test Laboratory	UnknownField dataUnknown
Comments:			
Attachments:			

The	ermal Treatment - Design					Fa	cility ID#:	0065
<u>x</u>	Thermal treatment:	Conducti	ve					
		Electrical	Resistance					
		_	3 phase	6 phase	A	C power	DC	power
		Steam	<u> </u>	<u> </u>				
		V Other (de	Steam	Steam + a	air S	team + O2		
	Type of Test:	X Other (dePilot test		RFH scale System				
_	Type of Test Geology of Treatment Zon	_		homogeneous and p	ermeable uncor	nsolidated se	diments	
-	_ Geology of Treatment 2011			homogeneous and in				
			-	ermeable sediments v	•			ahility material
				permeable sediments				-
				nt, but fractured bedro			9	,
				d bedrock, limestone,		,		
	Treatment Targe Zone:	Saturate	<u></u>	Vadose only		oth (Saturated	d and Vadose	zones)
	Start of Thermal Test:				ration:			
	Hydraulic Control	Yes	No					
	_ Treatment Cell Design:							
	Size of target zone (ft2):					Unknowi	n (x ft)
	Thickness of target zone (ft):				Unknowi	a	
	Depth to top of target zone	e (ft bgs):				Unknowi	n	
	Thickness of target zone b	elow water table	e (ft):			Unknow	n	
	Number of energy delivery	points:				Unknow	n	
	Number of extraction point	ts:		-		Unknow	n	
	Tarana anatana Bastila							
_	_ Temperature Profile:	no (do a C).					T.I	
	Initial formation temperatu					_	Unknown	
	Maximum representative f	· ·				_	Unknown	
	Time to reach maximum re	•		• •		_	Unknown	
	Duration of treatment at re	presentative ten	nperature (da				Unknown	
					Date		Temperatur	re (dea C)
	Formation temperature im-	mediately nost-ti	reatment:		Date		remperatur	ie (deg C)
	Formation temperature po			+1.				
	Duration of post-treatment		-					-
	Daration of poor troutinons	moning (aa)	٥,٠					
	Mass of contaminant remo	oved:						
	_	liquid pumping:			lt		kg	Unknow
		apor stream:					<u> </u>	Unknow
	Tota	•					kg	Unknow
						_	_ :	
	Comments:							
			·					
	Attachments:							

and Performance					Facility ID#:	<u>0065</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
	·					
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k۱	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m ³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:			_ \\\\\	күүшүүс
	1 lease	note other energy.				
Cost						
Total Project Cost:						
Co	onsultant Cost:					
Th	ermal Vendor Cost:					
	ergy Cost:			m³	_ yd³	
	her Cost 1:			<u> </u>	_ , -	
	her Cost 2:					
	her Cost 3:					
		Other Cost 1:				
Please note of		Other Cost 1:				
		Other Cost 2:				

File Analyzed By: PD ____ Date: ____Other: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post ___ Full Scale System Type of Test: Pilot Test Start of Test: End of Test: _____ Duration: _____ Type of Site: Non-DOD ___ DoD Facility Name: GATX Annex Terminal Address: City, State, Zip Code: San Pedro, CA OU# or Site #: Primary point of contact: Paul DePercin Organization: SITE/ US EPA Address: City, State, Zip Code: Phone #: <u>513-569-7797</u> email: ____ Other contacts or vendors who worked on site __ None Point of contact: ____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0070

General Site Information

___ Hydraulic Conductivity information

General Site As	sessment Data					Facility II	D#: <u>0070</u>		
Impacted	Impacted zone a	w direction)(ft.): as defined by documentation and for determining size of im			ness (ft):		Unknown		
	Map attachment	_	pacieu zone (See Source zo	ne definition attachmen	ns)				
Monitor V	Vells: Number of relevant r	nonitoring wells with groundy	vater data: Pre-treatment:		Post-treatment:		None		
	Number of wells rela	tive to treatment zone:	r to troument.		Tost treatment.				
	Pre-treatment	Pre-treatment In: Upgradient: Downgradient: Crossgradient:							
	Post-treatment	In:	Cros	ssgradient:					
Soil Borings: Number of relevant soil borings with pre-treatment data:									
		oil borings with post-treatmen							
	Number inside treatm	ent zone:	_ Number outside	treatment zone:					
Types of C	Contaminants								
				Average Pre-treatme Chem			ent Concentration per nical:		
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)		
	Trichloroethene	Hexane	Creosote	None	None	None	None		
	Tetrachloroethene	Jet Fuel		None	None	None	None		
	1,1-dichloroethene	Napthalene		None	None	None	None		
	cis-1,2-dichloroethene	Benzene		None	None	None	None		
	trans-1,2-dichloroethene	Tolune		None	None	None	None		
	1,1-dichloroethane	Ethylbenzene		None	None	None	None		
	1,2-dichloroethane	m/p-xylene		None	None	None	None		
Chaminala of	1,1,1-trichloroethane	o-xylene		None	None	None	None		
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None		
	1,1,2,2-tetrachloroethane			None	None	None	None		
	Vinyl Chloride			None	None	None	None		
	x Total VOCs			None	None	None	None		
				None	None	None	None		
				None	None	None	None		
				None	None	None	None		
				None	None	None	None		
				None	None	None	None		
Comme	nts:								
		8925 cubic ya	rds of contaminated soil -	total On	ly treated 65 cubic y	rards			
Attachmen	its:								

Hyd	rogeologic Conceptual	Model		Facility ID#: 007	<u>70</u>
	_ Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers (Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments with inter-bedded layers (Largely permeable sediments with inter-bedded lenses of Largely permeable sediments with inter-bedded layers (Largely impermeable sediments with inter-bedded layers (Largely i	d sediments lower permeability material of higher permeability material sediments d sediments lower permeability material	
<u>x</u>	Ground surface eleva	tion based on wells in o	adjacent to treatment zone: ft amsl	<u>x</u> Unknown	
<u>x</u>	Aquifer Characteristic Is more than 1 aquife Depth to water:		No Yes (number): X Aquifer 1 Aquifer 2 Aquifer 3 5	Unknown (assume single aquifer) — —	
	_ Flow direction			_	
X	Horizontal hydraulic g			<u>x</u> Unknown <u>x</u> Unknown	
<u>x</u>	K range (ft/day) Transmissivity (ft2/da	Measured low high Measured low high		Field dataX UnknownField dataX Unknown	
	Comments:				_
	Attachments:				_

The	rmal Treatment - Design								Facility ID#:	<u>0070</u>
<u>x</u>	Thermal treatment:		_ Conducti	ve						
			_ Electrical	l Resistance						
			_	3 phase	-	6 phase		AC power	DO	C power
		<u>X</u>	Steam	Steam		Steam + air		Steam + O2	2	
		_	Other (de	escribe)						
<u>x</u>	Type of Test: <u>x</u>	Pilo	t test	Ful	l-scale Sys	stem				
<u>x</u>	Geology of Treatment Zone	e:		Relatively Largely p Largely ii Compete	y homoge permeable mpermea ent, but fra	eneous and permeneous and impe es sediments with able sediments with actured bedrock (ck, limestone, sar	ermeable uniter-bedoith inter-bedoith inter-bedoithe.	inconsolida ded lenses edded layer	ted sediments	ability material meability material
	_ Treatment Targe Zone:		_ Saturate	ed only	\	adose only		Both (Satur	rated and Vadose	e zones)
	_ Start of Thermal Test:					_ Duratio	on:			
	_ Hydraulic Control		_ Yes	No						
	Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (f Depth to top of target zone b Number of energy delivery Number of extraction point Temperature Profile: Initial formation temperatur Maximum representative for Time to reach maximum re Duration of treatment at rep	(ft bg elow point s: re (de prmati	water table s: g C): ion temper	rature (deg (mperature (d	days):			Unkr Unkr Unkr Unkr Unkr	nown nown nown	n n
						1	<u>Date</u>		Temperatu	ire (deg C)
	Formation temperature imr	nedia	tely post-t	reatment:						
	Formation temperature pos	st-trea	atment mo	nitoring ever	nt 1:					
	Duration of post-treatment	moni	toring (day	/s):						
	_ Mass of contaminant remo									
			pumping:						kg	Unknow
		-	stream:	_				lb	kg	Unknow
	Tota	ıl:		_			-	lb	kg	Unknow
	Comments:									
	Attachments:									

Cost and Performance					Facility ID#:	<u>0070</u>
Performance						
Remediation Goal:						
rtomoulation ocali	- In Groundwater: -					
	 In Soil:					
Was the Remediation	on Goal Achieved:					
	In Groundwater					
	Comment: -					
	-					
	_ In Soil					
	Comment: -					
	-					
	_					
General comments	on the thermal applica	ation:				
	of the Toxic treatmen	nts (USA), Inc (TTUSA)	Detoxifer 2.	Cost based on	8925 cubic yards	of contaminated
<u>Soil</u>						
\$252 to \$3	317/cubic yards					
Lessons Learned						
_						
Energy						
Total Energy Used:			kWhr	kWhr/m ³		-
	tal energy applied to t	treatment zone:			kWhr/m ³	kWhr/yd ³
Oth	ner energy:				kWhr/m ³	kWhr/yd ³
	Please	note other energy:				
Cook						
Cost						
Total Project Cost:						
The	nsultant Cost:					
	ermal Vendor Cost:					
				_ m³	yd³	
En	ermal Vendor Cost:			_ m³	yd³	
En	ermal Vendor Cost: ergy Cost:			_ m³	yd³	
En Ott	ermal Vendor Cost: ergy Cost: ner Cost 1:			_ m³	yd³	
En Ott	ermal Vendor Cost: ergy Cost: ner Cost 1: ner Cost 2: ner Cost 3:	Other Cost 1:		_ m³	yd³	

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	7/28/2006
	Type of treatment:	Conductive	<u>x</u>	Steam _	ERH _	Other:		
	Type of Contaminant:	<u>x</u> Chlorinated Solv	ents	F	Petroleum Hydrocarl	oons	Pesticides	
		Wood Treating		(Other:			
	Treatment Status:	Active	<u>x</u>	Post				
	Type of Test:	<u>x</u> Pilot Test		Full Scale Sy	stem			
	Start of Test:	10/23/2002		End of	Test: <u>11/20/2002</u>		Duration: 29 da	<u>ıys</u>
	Type of Site:	Non-DOD	<u>x</u>	DoD				
<u>x</u>	Facility Name: Beale AFB	1						
	Address:							_
	City, State, Zip Code:	Marysville, CA						
	OU# or Site #: SWMU 23							
<u>x</u>	Primary point of contact:	Phil Welker						
	Organization: <u>URS</u>							
	Address:							
	City, State, Zip Code:							
	Phone #: 916-679-2262			email: phil_we	lker@urscorp.com			
<u>x</u>	Other contacts or vendors wh	no worked on site		_	None			
	Point of contact: Kent	: Hawley						
	Type: Vendor, Co	onsultant	_Ven	dor, Technical	Applications	<u>x</u> Oth	er <u>AFB</u>	
	Organization: Beale AFB	<u>!</u>						
	Address: 6601 B Street							
	City, State, Zip Code:	Beale AFB, CA 95903	-1708					
	Phone #: (530) 634-2657			email: kent.ha	wley@beale.af.mil			
Q	A/QC							
<u>x</u>	Characteristics of Interest							
_	Good pre- and post-trea	atment groundwater data		_	Good pre- and	post-treatme	nt soil data	
		ile vs. time information		_	Flux assessmen	-		
	Groundwater elevation			<u>-</u>				
	 <u>x</u> Hydraulic Conductivity 			_	-			

General Site Information

0080

Facility ID#:

General	Site Asses	ssment Data					Facility II	D#: <u>0080</u>
<u>x</u> Im	npacted Zo	Impacted zone a	as defined by documentation			kness (ft): <u>30</u>		Unknown
		 <u>x</u> Alternative meth <u>x</u> Map attachment 	nod for determining size of im	pacted zone (See source z	one definition attachme	ents)		
<u>x</u> N	Monitor Wel	ls: Number of relevant n	nonitoring wells with ground	vater data: Pre-treatment	: <u>10</u>	Post-treatment:	<u>10</u>	None
		Number of wells relat	tive to treatment zone:					
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
Sc	oil Borings:	Number of relevant so	oil borings with pre-treatment	data: <u>0</u>				
		Number of relevant so	oil borings with post-treatmer	t data: 11				
		Number inside treatme	ent zone: 0	Number outsid	le treatment zone:	<u>11</u>		
<u>x</u> Ty	pes of Con	ntaminants	1	T			T	
						nent Concentration per mical:		ent Concentration per nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	<u>x</u>	Trichloroethene	Hexane	Creosote	1 mg/L	None	0.1 mg/L	None
	<u>x</u>	Tetrachloroethene	Jet Fuel		0.1 mg/L	None	0.01 mg/L	None
	_	1,1-dichloroethene	Napthalene		None	None	None	None
	<u>x</u>	cis-1,2-dichloroethene	Benzene		0.001 mg/L	None	0.001 mg/L	None
	<u>x</u>	trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
Chami	icals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	icern	1,1,2-trichloroethane			None	None	None	None
	_	1,1,2,2-tetrachloroethane			None	None	None	None
	<u>x</u>	Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
	_				None	None	None	None
	_				None	None	None	None
	_				None	None	None	None
					None	None	None	None
	Comments	s: 5D.		Have screen intervals on	ı: BAI-01, 02, 04, 4S,		coordinates of some	wells pgs 5.7 and
		hydraulic conductivity po	3 6				e GW concs pg 7; pos	

Attachments:

Map for impacted zone pg 8

Hyd	rogeologic Conceptual	Model					Facility ID#	t: <u>0080</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relatively Largely in Competer Weathere Relatively Relatively Largely in Competer	homogeneous a homogeneous a ermeable sediment, but fractured led ded bedrock, limes homogeneous a homogeneous a ermeable sediment, but fractured let,	and impermeable ents with inter-ber iments with inter-ber bedrock (i.e. crys stone, sandstone and permeable ur and impermeable ents with inter-ber	nconsolidated sedi unconsolidated sed dded lenses of low bedded layers of h	ediments ver permeabili igher permea iments ediments ver permeabili	ity material
<u>x</u>	Ground surface eleve	ation based on wells in o	adjacent to trea	itment zone:	<u>130</u>	ft amsl		Unknown
X	Aquifer Characteristic Is more than 1 aquife Depth to water:		No Aquifer 1	Yes (number)	: quifer 2	Unk Aquifer 3	tnown (assume	e single aquifer)
		high value (ft bgs): Unknown:	<u>21</u>					
<u>x</u>	Flow direction		<u>sw</u>					
<u>x</u>	Horizontal hydraulic gravertical hydraulic graver	• , ,	0.012				<u>x</u>	Unknown Unknown
<u>x</u>	K range (ft/day)	Measured low high	sing:).75 14.3	_ Slug Test	Laborator	ry <u> </u>	Field data	Unknown
	Transmissivity (ft2/da	•		_ Slug Test	Laborato	гу	_ Field data <u>X</u>	Unknown
		uifer test conducted in	003 resulted in	n dwatering at	extraction point	at low flow rates	of 2.3 gpm	
	Attachments:							

The	ermal Treatment - Design							Facilit	ty ID#: <u>0</u>	080
<u>x</u>	Thermal treatment:		_ Conducti	ve						
_			_ Electrica	l Resistance						
				3 phase	_	6 phase	AC p	ower	DC pov	wer
		<u>x</u>	Steam	DUS/HPO						
			_	Steam	_	Steam + air	Steam	n + O2		
			Other (de	escribe)						
<u>x</u>	Type of Test: <u>x</u>	Pilot	test	Full-	scale Sys	stem				
<u>x</u>	Geology of Treatment Zor	ne:		Relatively	homoge	eneous and permea	able unconso	idated sedin	nents	
			_	Relatively	homoge	eneous and imperm	neable uncon	solidated sed	diments	
			_	Largely pe	ermeable	e sediments with in	ter-bedded le	nses of lowe	r permeabili	ty material
			<u>x</u>	Largely im	npermea	ble sediments with	inter-bedded	layers of hig	gher permea	bility materia
			_	Competer	nt, but fra	actured bedrock (i.e	e. crystalline r	rock)		
			_	Weathere	d bedro	ck, limestone, sand	stone			
<u>x</u>	Treatment Targe Zone:	<u>x</u>	Saturate	ed only	\	adose only	Both	(Saturated an	d Vadose zon	es)
<u>X</u>	Start of Thermal Test:	10/2	3/2002			Duration	: 29 days			
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>652</u>		-	Unknown	(<u>29</u>	x <u>29</u> ft)
	Thickness of target zone ((ft):			<u>15</u>			Unknown		
	Depth to top of target zone	e (ft bg	ıs):		<u>25</u>			Unknown		
	Thickness of target zone b	oelow v	water table	e (ft):	<u>15</u>			Unknown		
	Number of energy delivery	y point	S:		1			Unknown		
	Number of extraction poin	ts:			1			Unknown		
<u>x</u>	Temperature Profile:									
~	Initial formation temperatu	ıre (de	a C):			<u>21</u>			Unknown	
	Maximum representative f			rature (dea C):	100			Unknown	
	Time to reach maximum r		-			22			Unknown	
	Duration of treatment at re					<u>2</u>			Unknown	
				,	, -,	=				
						<u>Da</u>	<u>ite</u>	<u>Te</u>	emperature (deg C)
	Formation temperature im	media	tely post-t	reatment:		11/20/2002		100		
	Formation temperature po	st-trea	itment mo	nitoring even	t 1:	12/2/2002		<u>88</u>		
	Duration of post-treatmen	t monit	oring (day	/s):		Atleast 14 days	<u>3</u>			
	_ Mass of contaminant remo									
			pumping:	_			lb		kg _	Unknov
			tream:				lb		_	Unknov
	Tot	al:					lb		kg _	Unknov
	Comments:									
	12/0/06	_ 800								
	12/9/06	- 600								
	Attachments:									
							-			

Cost and Performance

Facility ID#: 0080

Performance
Remediation Goal:

<u>x</u>	In Groundwater:	
	1	. Destroy COCs, 2. heat up soil and groundwater by steam, and 3. maintain hydraulic control
	_ In Soil:	
Was the Remediation	Goal Achieved:	
<u>x</u>	In Groundwater	pp pp g
	Comment: co	ncentration levels from ~10,000 ug/L of VOCs to ~ 2,000 ug/L. Test was terminated; follow- n remedial technology applied in 2004 (ozone sparging) has reduced levels from ~2,000 ug/L
	to to	<500 ug/L; system is still operating at site.
	_ In Soil	
	Comment: —	
General comments of	n the thermal applica	tion:
Aquifer region in	mmediately adjacent	to extraction well dried out
Lessons Learned		
_		
Energy		
Total Energy Used:		kWhrkWhr/m³kWhr/yd³
Tota	al energy applied to tr	
Othe	er energy:	kWhr/m ³ kWhr/yd ³
	Please r	note other energy:
0		
Cost		
Total Project Cost:		
<u>x</u> Con	sultant Cost:	930,160
The	rmal Vendor Cost:	
Ene	rgy Cost:	m³ yd³
Othe	er Cost 1:	
Othe	er Cost 2:	
Othe	er Cost 3:	
Please note oth	er cost:	Other Cost 1:
		Other Cost 2:
	_	Other Cost 2:

PD ____ File Analyzed By: Date: 10/18/2006 ____Steam ____Other: Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating _Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: _____ Type of Site: __Non-DOD ___ DoD Facility Name: Pemaco Superfund Site Address: City, State, Zip Code: Los Angelos County, CA OU# or Site #: Primary point of contact: Tim Garvey Organization: TN & Associates Address: City, State, Zip Code: Ventura, CA 93001 Phone #: 805-585-6386 email: Other contacts or vendors who worked on site _ None Point of contact: **David Flemings** Type: Vendor, Consultant ____ Vendor, Technical Applications __Other Organization: TRS Address: City, State, Zip Code: Phone #: 425-396-4266 email: dfleming@thermalrs.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section ___ Hydraulic Conductivity information

Facility ID#:

0085

Inspected Zone Length (parallel to flow directory)(h): Impacted zone as defined by documentation Abarrative methods for determining size of impacted zone (See source zone definition attachments) Abarrative methods for determining size of impacted zone (See source zone definition attachments) Moreor Wells: Number of relevant monitoring wells with goundwater data: Pro-tiestment Pro-tiestment Pro-tiestment Pro-tiestment Pro-tiestment Pro-tiestment In: Upgradient: Downgradient: Crossgradient: Pro-tiestment In: Upgradient: Downgradient: Crossgradient: Pro-tiestment In: Upgradient: Downgradient: Crossgradient: Pro-tiestment In: Number of relevant soil borings with pre-treatment data: Number relable heatment zone: Types of Contaminates Average Pre-treatment Concentration per Communitation Trippes of Contaminates Average Pre-treatment Concentration per Communitation Trippes of Contaminates Average Pre-treatment Concentration per Average Pro-treatment Concentration per Communitation Average Pre-treatment Concentration per Consuments Average Pre-treatm	General Site As	sessment Data					Facility II	D#: <u>0085</u>
	Impacted	= "			Thick	ness (ft):		Unknown
Monitor Wells: Number of relevant monitoring wells with groundwater data:		 •	•		ne definition attachmer	its)		
Monitor Wells: Number of relevant monitoring wells with groundwater data: Pre-treatment Pr				,		,		
Per-treatment Prost-treatment Prost-treatm								
Number of wells relative to treatment zone: Pre-treatment In: Upgradient: Downgradient: Crossgradient: Post-treatment In: Upgradient: Downgradient: Crossgradient: Number of relevant soil borings with pre-treatment data: Number of relevant soil borings with post-treatment data: Number of relevant soil borings with post-treatment data: Number outside treatment zone: Types of Contaminants Types of Contaminants Average Pre-treatment Zone: Chemical: Chlorinated Solvents Pendeum Hydrocarbons Other Groundwater (mg.T.) Soil (mg.kg) Groundw	Monitor V	Vells: Number of relevant m	nonitoring wells with groundy			Post-treatment:		None
Pre-treatment In: Upgradient: Downgradient: Crossgradient: Crossgr		Number of wells relati	ive to treatment zone:	T TO LIGHTION.				
Soil Borings: Number of relevant soil borings with pre-treatment data: Number inside treatment zone: Number inside treatment zone: Number outside treatment zone: None outside treatmen				Upgradient:	Downgradient:	Cros	ssgradient:	
Number of relevant soil borings with post-treatment data: Number inside treatment zone: Number outside treatment zone:		Post-treatment	In:					
Number of relevant soil borings with post-treatment data: Number inside treatment zone: Number outside treatment zone:								
Types of Contaminants	Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
Types of Contaminants	Impacted zone as defined by documentation Alternative method for determining size of impacted zone (See source zone definition attachments) Map attachment Map attachmen							
Average Pro-treatment Concentration per Chemical:		Number inside treatme	ent zone:	Number outside	treatment zone:			
Average Pro-treatment Concentration per Chemical: Chlorinated Solvents								
Chemical: Chem	Types of C	Contaminants			11			
X Trichloroethene								
Tetrachloroethene		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
1,1-dichloroethene		x Trichloroethene	Hexane	Creosote	50 mg/L	None	None	None
Cis-1,2-dichloroethene Benzene None None None None None		Tetrachloroethene	Jet Fuel		None	None	None	None
trans-1,2-dichloroethane		1,1-dichloroethene	Napthalene		None	None	None	None
1,1-dichloroethane		cis-1,2-dichloroethene	Benzene		None	None	None	None
1,2-dichloroethane		trans-1,2-dichloroethene	Tolune		None	None	None	None
1.1,1-trichloroethane		1,1-dichloroethane	Ethylbenzene		None	None	None	None
Chemicals of Concern		1,2-dichloroethane	m/p-xylene		None	None	None	None
Concern	Chamicala of	1,1,1-trichloroethane	o-xylene		None	None	None	None
None		1,1,2-trichloroethane			None	None	None	None
None None None None None		1,1,2,2-tetrachloroethane			None	None	None	None
None		Vinyl Chloride			None	None	None	None
None					None	None	None	None
None					None	None	None	None
None					None	None	None	None
Comments:					None	None	None	None
Comments:					None	None	None	None
					None	None	None	None
Attachments:	Comme	nts:						
Attachments:								
Attachments:								
Attachments:				-				
	Attachmer	nts:						

Hyd	rogeologic Conceptua	al Model		Facility ID#: 0085
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sediments	
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated se	diments
			Relatively homogeneous and impermeable unconsolidated	sediments
			Largely permeable sediments with inter-bedded lenses of lo	ower permeability material
			Largely impermeable sediments with inter-bedded layers of	higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated se	diments
			Relatively homogeneous and impermeable unconsolidated	sediments
			Largely permeable sediments with inter-bedded lenses of lo	ower permeability material
			Largely impermeable sediments with inter-bedded layers of	higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
	_ Ground surface ele	vation based on wells in o	adjacent to treatment zone: ft amsl	Unknown
	A'f Oht'-	· ·		
<u>X</u>	Aquifer Characteris		N. V. (L.)	(1
	Is more than 1 aqui	iler present?	No Yes (number): U Aquifer 1 Aquifer 2 Aquifer 3	nknown (assume single aquifer)
	Depth to water:	low value (ft bgs):	60	
	Deptil to water.	high value (ft bgs):	<u> </u>	-
		Unknown:		-
		C		-
	Flow direction			
	_			-
	_ Horizontal hydraulid	c gradient (feet/foot):		Unknown
	Vertical hydraulic g	radient (feet/foot):		Unknown
	_ K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
		low		Unknown
		high		_
	Transmissivity (ft2/d	day): Measured	using: Slug Test Laboratory	Field data
		low		Unknown
		high		_
	Comments:			
	_			

Attachments:

Ther	rmal Treatment - Design							Fa	cility ID#:	0085
<u>x</u>	Thermal treatment:		Conductive	e						
_		<u>x</u>	Electrical l							
				_ 3 phase		6 phase		AC power	DC	power
			Steam	_ Steam		Steam + air	:	Steam + O2		
			Other (des	cribe)						
<u>x</u>	Type of Test:	_ Pilot	test	<u>x</u> Full-	scale System					
	Geology of Treatment Zone	e:		_	_	ous and permeal				
			· ·	_ ,	•	ous and imperme				
						diments with inte				•
									higher perr	neability material
				_		red bedrock (i.e.	-	ine rock)		
	Treatment Torre Zone		Caturatad	-		imestone, sands		Deale (Controlled	1 1 37 . 1	
<u>X</u>	Treatment Targe Zone: Start of Thermal Test:		Saturated	only	Vado	•		Both (Saturated		
<u>X</u>	Hydraulic Control	Jun-(No		Duration.	-			
	_ riyuradiic Control		Yes	10						
	_Treatment Cell Design:									
	Size of target zone (ft2):				13200			Unknow	n (_ x ft)
	Thickness of target zone (ft	:):			20			Unknow		
	Depth to top of target zone		s):		60			Unknow	n	
	Thickness of target zone be	elow v	vater table	(ft):	<u>35</u>			Unknow	n	
	Number of energy delivery	points	s:					Unknow	n	
	Number of extraction points	3:						Unknow	n	
	Temperature Profile:									
	Initial formation temperature	e (deg	g C):						Unknown	
	Maximum representative fo	rmatio	on tempera	ture (deg C):				Unknown	
	Time to reach maximum re	prese	ntative tem	perature (da	ays):				Unknown	
	Duration of treatment at rep	reser	ntative temp	perature (da	ays):				Unknown	
						<u>Dat</u>	<u>:e</u>		Temperatu	re (deg C)
	Formation temperature imn	nediat	ely post-tre	atment:						
	Formation temperature pos			-	t 1:					
	Duration of post-treatment	monite	oring (days):						
	Manager									
-	Mass of contaminant remov		oumping:				,	lh.	lea	Unknown
			tream:				1	·	kg	Unknown
	Tota		ireaiii.				1		kg	Unknown
	Tota						1		kg	UIKIIOWII
	Comments:									
										
	Attachments:									<u></u>

and Performance					Facility ID#:	0085
_ Performance						
Remediation Goal:	_					
	In Groundwater: -					
	In Soil:					
	<u> </u>					
Was the Remediation						
	·					
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
			kWhr	Is\A/la =/n=3	1.1	M/h=/.cd ³
Total Energy Used:	· · · · · · · · · · · · · · · · · · ·		KWNr			
	tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd
Oth	ner energy:				_ kWhr/m ³	kWhr/yo
	Please	note other energy:				
Cost						
Total Project Cost:						
-						
	nsultant Cost:					
	ermal Vendor Cost:	_		3	.3	
	ergy Cost:				_ yd³	
	ner Cost 1:	-				
	ner Cost 2:					
	ner Cost 3:					
Please note of	ther cost:	Other Cost 1:				
		Other Cost 2:				

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	5/1/2007
	Type of treatment:	x Conductive	Steam	ERH	Other:		
	Type of Contaminant:	 X Chlorinated So 		Petroleum Hydroc		Pesticides	
	,,	Wood Treating		Other:			
	Treatment Status:	Active	<u>x</u> Post				
	Type of Test:	x Pilot Test	Full Scal	e System			
	Start of Test:	<u>Jul-04</u>	Enc	of Test: Nov-05		Duration: 480 c	day
	Type of Site:	<u>x</u> Non-DOD	DoD				
<u>x</u>	Facility Name: Carson, C	<u>'A</u>					
	Address:						_
	City, State, Zip Code:	Carson, CA					
	OU# or Site #:						
<u>X</u>	Primary point of contact:	John Bierschenk					
	Organization: <u>TerraTher</u>	<u>rm</u>					
	Address: 10 Stevens Rd						
	City, State, Zip Code:	Fitchburg, MA 01420					
	Phone #: <u>978-343-0300</u>		email: <u>jbi</u>	erschenk@terratherm.co	<u>om</u>		
	Other contacts or vendors w	ho worked on site		None			
	Point of contact:						
	Type:Vendor, C	Consultant	Vendor, Techn	ical Applications	Oth	er	
	Organization:						
	Address:						
	City, State, Zip Code:						
	Phone #:		email:				
Q	A/QC						
<u>X</u>	Characteristics of Interest						
		eatment groundwater da		_	nd post-treatmen	ıt soil data	
		file vs. time information	1	Flux assessn			
	Groundwater elevation			Geologic cro	oss-section		
	Hydraulic Conductivit	ty information					

Facility ID#:

0090

•	General Site As	sessment Data					Facility II	D#: <u>0090</u>
-	Impacted	= "		Width (ft):	Thick	ness (ft):		Unknown
		Impacted zone a	s defined by documentation					
		Alternative method	od for determining size of im	pacted zone (See source zo	ne definition attachmer	nts)		
		Map attachment						
2	x Monitor V	Vells: Number of relevant m	onitoring wells with groundy	vater data:				None
				Pre-treatment:	<u>6</u>	Post-treatment:	<u>5</u>	
		Number of wells relati	ve to treatment zone:					
		Pre-treatment	In: <u>6</u>	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In: <u>5</u>	Upgradient:	Downgradient:	Cro	ssgradient:	
2	x Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data: <u>12</u>				
		Number of relevant so	il borings with post-treatmen	nt data: 9				
		Number inside treatme	ent zone: <u>12/9</u>	Number outside	treatment zone:			
2	x Types of C	Contaminants						
					Average Pre-treatme	ent Concentration per	Average Post-treatm	ent Concentration per
					Chen	nical:	Cher	nical:
r		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		X Trichloroethene	Hexane	Creosote	10 mg/L	10 mg/kg	1 mg/L	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		x cis-1,2-dichloroethene	Benzene		None	0.5 mg/kg	None	None
		x trans-1,2-dichloroethene	Tolune		None	0.01 mg/kg	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		x 1,2-dichloroethane	m/p-xylene		5,000 mg/L	1,000 mg/kg	10 mg/L	None
	Chamicala of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,2-trichloroethane			None	None	None	None
Chemicals of		1,1,2,2-tetrachloroethane			None	None	None	None
		<u>X</u> Vinyl Chloride			10 mg/L	10 mg/kg	0.5 mg/L	None
		x Total CVOCs 20 ft			None	500 mg/kg	None	1 mg/kg
		x Total CVOCs 25 ft			None	1,000 mg/kg	None	1 mg/kg
	x Total CVOCs 30 ft			None	1,000 mg/kg	None	10 mg/kg	
		<u>x</u> Total CVOCs 35 ft			None	5,000 mg/kg	None	100 mg/kg
					None	None	None	None
L					None	None	None	None
	Comme	ents:						
		·	<u> </u>					<u></u>
	Attachmer	nts:						

Hyd	rogeologic Conceptu	al Model		Facility ID#: 0090
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sediments	
		Vadose Zone:	Relatively homogeneous and permeable unconsolidate	ed sediments
			Relatively homogeneous and impermeable unconsolid	ated sediments
			Largely permeable sediments with inter-bedded lenses	s of lower permeability material
			\underline{x} Largely impermeable sediments with inter-bedded layer	ers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
		Saturated Zone:	Relatively homogeneous and permeable unconsolidate	ed sediments
			Relatively homogeneous and impermeable unconsolid	ated sediments
			Largely permeable sediments with inter-bedded lenses	of lower permeability material
			x Largely impermeable sediments with inter-bedded layer	ers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
<u>X</u>	Aquifer Characteris Is more than 1 aqui Depth to water:			Unknown (assume single aquifer) 3
	_ Flow direction			
<u>X</u>	•	c gradient (feet/foot):	0.002 to 0.004	Unknown
	Vertical hydraulic g	radient (feet/foot):	0.141	Unknown
<u>x</u>	K range (ft/day)	Measured low high	using: Slug Test <u>x</u> Laboratory 1.44	Field data
	Transmissivity (ft2/c	g .	using:Slug TestLaboratory	Field data
		low		
		high		
		J		

Comments:

Attachments:

The	rmal Treatment - Design					Facility ID#:	0090
<u>x</u>	Thermal treatment:	x Conductive					
		Electrical Resistance					
				6 phase	AC power	DC	oower
		Steam Steam		_Steam + air	Steam + C)2	
		Other (describe)					
<u>x</u>	Type of Test: <u>x</u>	Pilot test Full-	scale Systen	1			
<u>x</u>	Geology of Treatment Zone:	: Relatively	homogene	ous and permea	ble unconsolidate	ed sediments	
		Relatively	homogene	ous and imperm	eable unconsolid	ated sediments	
		Largely pe	ermeable se	ediments with int	er-bedded lenses	of lower permea	bility material
		<u>x</u> Largely im	permeable	sediments with	inter-bedded laye	ers of higher perm	eability material
		Competer	nt, but fractu	ured bedrock (i.e	. crystalline rock)		
			d bedrock,	limestone, sands	stone		
<u>X</u>	ů.	Saturated only	x Vado	ose only		rated and Vadose z	cones)
<u>X</u>		<u>Jul-04</u>		Duration:	480 day		
<u>x</u>	Hydraulic Control	Yes <u>x</u> No					
<u>x</u>	Treatment Cell Design:						
	Size of target zone (ft2):		<u>7200</u>		Unk	nown (<u>8</u>	0 x <u>120</u> ft)
	Thickness of target zone (ft)	:	<u>20</u>		Unk	nown	
	Depth to top of target zone ((ft bgs):	<u>17</u>		Unk	nown	
	Thickness of target zone bel	low water table (ft):	<u>17</u>		Unk	nown	
	Number of energy delivery p	points:	<u>29</u>		Unk	nown	
	Number of extraction points:	:	<u>6</u>		Unk	nown	
<u>x</u>	Temperature Profile:						
	Initial formation temperature	(deg C):		<u>21</u>		Unknown	
	Maximum representative for	mation temperature (deg C):	<u>100</u>		Unknown	
	Time to reach maximum rep	resentative temperature (da	ays):	<u>231</u>		Unknown	
	Duration of treatment at repr	resentative temperature (da	ıys):	<u>253</u>		Unknown	
				<u>Dat</u>	<u>e</u>	Temperature	e (deg C)
	Formation temperature imme	ediately post-treatment:		11/8/2005		<u>100</u>	
	Formation temperature post-	-treatment monitoring even	t 1:				
	Duration of post-treatment m	nonitoring (days):					
<u>x</u>	Mass of contaminant remove	ed:					
	Via lic	quid pumping:			lb	kg	Unknow
	In vap	por stream:			lb	kg	Unknow
	Total:	:	24800 (1,2	-DCA)	<u>x</u> lb	kg	Unknow
	Comments:						
	22 ft spaci	ing between thermal well:	s, approx	imately 250 to	330 watts/ft pov	wer input to each	n well. Treated
	3,233 yd3.						
	Attachments:						

Cost and Perform	ance				Facility ID#:	0090
Performance	Э					
Remediation	n Goal:					
	In Groundwater: -					
	In Soil:					
\\\ 4b - D	mediation Goal Achieved:					
was the Rei						
	In Groundwater Comment: —					
	Comment.					
	In Soil					
	Comment:					
	Comment.					
	_					
General con	nments on the thermal applica	ation:				
Lessons Lea	CA groundwater concentration ent zone, were reduced from 9).	er below thermal treater below the bel	I clay and 2) evalua atment zone.	two monitor wellsction (MW-18); and	moval would have	eneath thermal mg/l or 99.98%
	Please	note other energy:				
Cost						
Cost Total Projec	t Cost					
Total Flojec	Consultant Cost:					
-	Thermal Vendor Cost:					
	Energy Cost:			m^3	yd³	
-	Other Cost 1:				,~	
_	Other Cost 1:					
-	Other Cost 2:					
Dlacas		Othor Cost 1:				
Please	e note other cost:	Other Cost 1:				
	_	Other Cost 2:				
	_	Other Cost 3:				

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date	e:	10/30/2006
	Type of treatment:	Conductive		Steam	<u>x</u>	ERH	Other	:		
	Type of Contaminant:	<u>x</u> Chlorinated Solv	ents		Petr	oleum Hydro	ocarbons		_Pesticides	
		Wood Treating			Othe	er:				
	Treatment Status:	Active	<u>x</u>	Post						
	Type of Test:	Pilot Test	<u>x</u>	Full Scale	e Syste	m				
	Start of Test:			End	of Test	t:		Du	ration:	
	Type of Site:	<u>x</u> Non-DOD		DoD						
<u>x</u>	Facility Name: Operating	Dry Cleaner								
	Address:									_
	City, State, Zip Code:	Carson, CA								
	OU# or Site #:									_
<u>x</u>	Primary point of contact:	Bill Heath								
_	Organization: CES									
	Address: 419 W. Entiat St									
	City, State, Zip Code:	Kennewick, WA 99336	5							
	Phone #: <u>509-727-4276</u>			email: bill@	@cesiwe	eb.com				
<u>x</u>	Other contacts or vendors wh	no worked on site				_ None				
	Point of contact: <u>Jame</u>	es Keegan								
	Type: <u>x</u> Vendor, C	onsultant	_Venc	lor, Techni	cal Ap	plications		Other		
	Organization: <u>TerraVac</u>									
	Address: 1211 N Barsten	Way								
	City, State, Zip Code:	Anaheim, CA 92806								
	Phone #: <u>714-666-1974</u>			email: jke	egan@	terravac.com	1			
Q	A/QC									
	Characteristics of Interest									
	_					Good pro	and post-trea	tment soil a	lata	
	Good temperature prof		ı		-		-	ament SOH (ıata	
	Groundwater elevation				-	_Flux asses				
	Groundwater elevation Hydraulic Conductivity					_ Geologic (cross-section			

Facility ID#:

0095

General Site As	ssessment Data					Facility II	D#: <u>0095</u>
Impacted	Impacted zone a	direction)(ft.): Width (ft): Thickness (ft): defined by documentation d for determining size of impacted zone (See source zone definition attachments)					Unknown
	Alternative meth	od for determining size of im	opacted zone (See source zo	ne definition attachmer	its)		
Monitor \	Wells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
		ive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
Soil Borin	=	il borings with pre-treatment					
	Number of relevant so	il borings with post-treatmer	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
x Types of 0	Contaminants						
				Average Pre-treatme	ent Concentration per nical:		
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	None	None	None	None
	x Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None		None
	cis-1,2-dichloroethene	Benzene		None	None		None
	trans-1,2-dichloroethene	Tolune		None	None		None
	1,1-dichloroethane	Ethylbenzene		None	None		None
	1,2-dichloroethane	m/p-xylene		None	None		None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None		None
Chemicals of Concern	1,1,2-trichloroethane			None	None		None
Concern	1,1,2,2-tetrachloroethane			None	None	None	None
	X Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None None None None None None None None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
					_		
Attachme	nts:						

Hydı	rogeologic Conceptual	Model		Facility ID#: 0095
	_Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of low Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of low Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material higher permeability material diments sediments wer permeability material
			adjacent to treatment zone: ft amsl	Unknown
<u>X</u>	Aquifer Characteristic		V ()	
	Is more than 1 aquife Depth to water:		No Yes (number): Un	iknown (assume single aquifer)
	Flow direction			
	_ Horizontal hydraulic g Vertical hydraulic grad			Unknown
	_K range (ft/day)	Measured	ising: Slug Test Laboratory	Field data
	Transmissivity (ft2/da	low high y): Measured of low high	Ising:Slug TestLaboratory	Unknown Field data Unknown
	Comments:			
	Attachments:			

Ther	mal Treatment - Design							Fa	acility ID#:	0095
<u>x</u>	Thermal treatment:		Conductiv	e						
_		x	=	Resistance						
		_	Staam	_ 3 phase	_	6 phase		AC power	DC	power
			Steam	_ Steam	_	Steam + air	:	Steam + O2		
			Other (des	cribe)						
<u>x</u>	Type of Test:	Pilot		_	scale Syst					
<u>x</u>	Geology of Treatment Zone):	· ·	_	_	neous and permea neous and imperm				
				_ Largely pe	ermeable	sediments with inte	er-bedd	ed lenses of I	ower perme	ability material
			<u>x</u>	Largely im	npermeab	le sediments with	inter-bed	dded layers o	f higher perr	neability material
				_ Competer	nt, but frac	ctured bedrock (i.e	. crystal	line rock)		
				_ Weathere	d bedrock	x, limestone, sands	stone			
<u>x</u>	Treatment Targe Zone:		Saturated	l only	Va	dose only		Both (Saturate	d and Vadose	zones)
	Start of Thermal Test:					Duration:				
	_ Hydraulic Control		Yes	No						
	_Treatment Cell Design:									
	Size of target zone (ft2):							Unknow	n (x ft)
	Thickness of target zone (ft):			<u>20</u>		-	Unknow	n	
	Depth to top of target zone	(ft bg	s):		8			Unknow	n	
	Thickness of target zone be	elow w	ater table	(ft):				Unknow	n	
	Number of energy delivery	points	::		<u>13</u>			Unknow	'n	
	Number of extraction points	s:			<u>15</u>		-	Unknow	n	
	Temperature Profile:									
	Initial formation temperature	e (deg) C):						Unknown	
	Maximum representative fo	rmatio	on tempera	ture (deg C):				Unknown	
	Time to reach maximum re	oresei	ntative tem	perature (da	ays):				Unknown	
	Duration of treatment at rep				-			_	Unknown	
				(<i>y</i> - <i>y</i>					
						<u>Dat</u>	<u>te</u>		Temperatu	re (deg C)
	Formation temperature imm	nediat	ely post-tre	eatment:						
	Formation temperature pos	t-treat	ment mon	itoring event	t 1:					
	Duration of post-treatment	monito	oring (days	s):						
	Mass of contaminant remov	/ed:								
	Via I	iquid p	oumping:				1	lb _	kg	Unknown
	In va	por st	ream:				1	lb	kg	Unknown
	Tota	l:					1	lb	kg	Unknown
	Comments:									
	Attachments:									

and Performance					Facility ID#:	0095
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_						
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k۱	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:				күүшүүс
	1 lease	note other energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
 Th	ermal Vendor Cost:					
	ergy Cost:	•		m³	_ yd³	
	her Cost 1:				_ / =	
	her Cost 1:	-				
	her Cost 3:					
Please note of		Other Cost 1:				
riease note of		Other Cost 1:				
		Other Cost 2:				

General Site Information Facility ID#: 0110 File Analyzed By: $\mathsf{JT} \quad \underline{\mathsf{x}} \qquad \mathsf{PD} \quad \underline{\mathsf{x}}$ Date: 9/18/2006 ____Other: Type of treatment: ERH ____ Conductive Steam _____Pesticides Type of Contaminant: _ Chlorinated Solvents Petroleum Hydrocarbons ____ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: <u>x</u> Pilot Test Full Scale System Start of Test: 3/27/1997 End of Test: 8/14/1997 Duration: 137 days Type of Site: ____Non-DOD DoD <u>X</u> Facility Name: <u>Defense Fuel Support Point</u> Address: 3171 N Gaffey St. City, State, Zip Code: San Pedro, CA OU# or Site #: Primary point of contact: Paul Rogers Organization: Address: City, State, Zip Code: Phone #: 703-767-8318 email: paul.rogers@dla.mil Other contacts or vendors who worked on site __ None Point of contact: Neil Irish Type: X Vendor, Consultant ____ Vendor, Technical Applications __Other Organization: The Source Group Address: 1962 Freeman Ave City, State, Zip Code: Signal Hill, CA 90755 Phone #: <u>562-597-1055</u> email: nirish@thesourcegroup.net QA/QC

Characteristics of Interest	
Good pre- and post-treatment groundwater data	Good pre- and post-treatment soil data
Good temperature profile vs. time information	Flux assessment
Groundwater elevations	Geologic cross-section
Hydraulic Conductivity information	

General Site	Assessment	Data						Facility I	D#: <u>0110</u>
<u>x</u> Impac	ted Zone:		as defined by documentation od for determining size of im	Width pacted zone (So		_	kness (ft):		Unknown
<u>x</u> Monito	or Wells:	Number of relevant m	nonitoring wells with groundw		e-treatment:	<u>13</u>	Post-treatment:	<u>13</u>	None
		Number of wells relat	ive to treatment zone:						
		Pre-treatment	In: <u>0</u>	Upgradient:	<u>6</u>	Downgradient:	<u>2</u> Cro	ossgradient: 5	
		Post-treatment	In: <u>0</u>	Upgradient:	<u>6</u>	Downgradient:	<u>2</u> Cro	ossgradient: <u>5</u>	
	Soil Borings: Number of relevant soil borings with pre-treatment data: 13 Number of relevant soil borings with post-treatment data: 0 Number inside treatment zone: 13 Number outside treatment zone: 0 Types of Contaminants								
							ent Concentration per mical:		nent Concentration per mical:
	С	hlorinated Solvents	Petroleum Hydrocarbons	Othe	er	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Tri	chloroethene	Hexane	Creosote		None	None	None	None
	Tet	rachloroethene	Jet Fuel			None	None	None	None
	1,1	-dichloroethene	Napthalene			None	None	None	None
	cis-	-1,2-dichloroethene	x Benzene			0.001 mg/L	0.01 mg/kg	None	None
	trai	ns-1,2-dichloroethene	x Tolune			0.001 mg/L	0.01 mg/kg	None	None
	1,1	-dichloroethane	x Ethylbenzene			0.001 mg/L	0.01 mg/kg	None	None
	1,2	-dichloroethane	x m/p-xylene			0.001 mg/L	0.01 mg/kg	None	None
	1,1	,1-trichloroethane	x o-xylene			0.001 mg/L	0.01 mg/kg	None	None
Chemicals Concern		,2-trichloroethane	<u>x</u> <u>JP 4</u>		·	1 mg/L	1,000 mg/kg	None	None
		,2,2-tetrachloroethane	<u>x JP 5</u>			1 mg/L	1,000 mg/kg	None	None
	Vir	nyl Chloride	x <u>Diesel</u>			1 mg/L	1,000 mg/kg	None	None
			x TPHd			1 mg/L	1,000 mg/kg	None	None
			x TPHg		<u> </u>	0.01 mg/L	10 mg/kg	None	None
					<u> </u>	None	None	None	None
						None	None	None	None
						None	None	None	None
					•	None	None	None	None
			·					•	
Com	nments:								
	_								
	_								
	_								

Figure 3 (impacted zone) - defined from cross-section map and borehole data

Attachments:

Нус	drogeologic Conceptual	Model				Facility ID#:	0110
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Se	ediments			
		Vadose Zone:	Relatively hor	mogeneous and permeable	unconsolidated se	diments	
			Relatively hor	mogeneous and impermeat	ole unconsolidated	sediments	
			x Largely perme	eable sediments with inter-l	pedded lenses of lo	wer permeability	y material
			Largely imper	meable sediments with inte	er-bedded layers of	higher permeab	ility material
			Competent, b	ut fractured bedrock (i.e. cr	ystalline rock)		
			Weathered be	edrock, limestone, sandstor	ne		
		Saturated Zone:	Relatively hor	mogeneous and permeable	unconsolidated see	diments	
			Relatively hor	mogeneous and impermeat	ole unconsolidated :	sediments	
			x Largely perme	eable sediments with inter-l	pedded lenses of lo	wer permeability	y material
				meable sediments with inte	er-bedded layers of	higher permeab	ility material
			Competent, b	ut fractured bedrock (i.e. cr	ystalline rock)		·
				edrock, limestone, sandstor			
				, , , , , , , , , , , , , , , , , , , ,			
<u>x</u>		ation based on wells in	or adjacent to treatme	ent zone: 40	ft amsl		Jnknown
<u>x</u>	Aquifer Characteristic						
	Is more than 1 aquife	er present?		Yes (number):		nknown (assume s	single aquifer)
			Aquifer 1	Aquifer 2	Aquifer 3		
	Depth to water:	low value (ft bgs):	<u>24</u>				
		high value (ft bgs):	<u>25</u>				
		Unknown:					
<u>X</u>	Flow direction		<u>NE - E</u>	 .		=	
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):	0.008 to 0.04			t	Jnknown
	Vertical hydraulic gra	adient (feet/foot):		- <u></u> -		<u>x</u> (Unknown
<u>x</u>	K range (ft/day)	Measured	d using: SI	ug Test Labora	itory	Field data	
		low		. .		<u>x</u> (Jnknown
		high		<u> </u>			
	Transmissivity (ft2/da	ay): Measured	d using: SI	ug Test Labora	tory	Field data	
		low		<u> </u>		<u>x</u> I	Jnknown
		high					

Attachments:

aquifer DTW is 11 to 31 feet regionally and regional flow is to the NW, but different in treatment area

Comments:

The	rmal Treatment - Desiç	gn				Facility ID#:	<u>0110</u>
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Resistar					
		3 pha		_ 6 phase	AC power	DC	power
		<u>x</u> Steam Other (describe)		_ Steam + air	Steam + O2	2	
<u>x</u>	Type of Test:		Full-scale Syster	n			
<u>x</u>	Geology of Treatmer		-		able unconsolidate	d sediments	
^	Coology of Troutino		,	•	neable unconsolida		
				•	ter-bedded lenses		ability material
					inter-bedded layer	•	•
					e. crystalline rock)		•
				limestone, sand			
<u>x</u>	Treatment Targe Zor		Vad			rated and Vadose	zones)
<u>x</u>	Start of Thermal Tes	t: <u>3/27/1997</u>		Duration	: <u>137 days</u>		
<u>x</u>	Hydraulic Control	Yes <u>x</u>	No				
<u>x</u>	Treatment Cell Design	an:					
^	Size of target zone (f				<u>x</u> Unkı	nown (_ x ft)
	Thickness of target z				_	nown	,
	Depth to top of targe				<u> </u>	nown	
		cone below water table (ft):	<u>15</u>		_	nown	
	Number of energy de	elivery points:	<u>3</u>		Unki	nown	
	Number of extraction	points:	1		Unki	nown	
<u>x</u>	Temperature Profile:						
_	Initial formation temp			<u>21</u>		Unknown	
	·	ative formation temperature (d	eg C):	90		Unknown	
	Time to reach maxim	num representative temperatu	e (days):	<u>85</u>		Unknown	
	Duration of treatmen	t at representative temperatur	e (days):	<u>40</u>		Unknown	
				<u>Da</u>	<u>te</u>	<u>Temperatu</u>	re (deg C)
	Formation temperatu	re immediately post-treatmen	t:				
	Formation temperatu	re post-treatment monitoring	event 1:				
	Duration of post-trea	tment monitoring (days):					
<u>x</u>	Mass of contaminant	t removed:					
		Via liquid pumping:			lb	kg	Unknown
		In vapor stream:			lb	kg	Unknown
		Total:	220	<u>0</u>	lb	<u>x</u> kg	Unknown
	Comments: <u>Tot</u>	al mass was 800 gallons of	Diesel, etc.			01	alla inatalla d
	(2	not used); Recovery wells	installed - 2 (1	not used)		steam w	ells installed - 5 Said
	20	ft radius of influence and 20	ft columnar po	er injection well	<u> </u>		
	Attachments:						
	<u> </u>						

					Facility ID#:	<u>0110</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	-					
	In Soil:					
Was the Remediation	on Coal Ashiovade					
	in Groundwater _ Comment: =					
	Comment. –					
	 In Soil					
	Comment:					
	-					
	_					
General comments	on the thermal applic	ation:				
Target temp of	f 150F in vados					
	1 1301 III vauos					Basis of success
zone						
from recovery	data and that was on	ly graphic showing reco	overy rate and cur	nulative recovery		Boilers only r
from recovery	data and that was on h many at 4 hours. T	nly graphic showing reco	overy rate and cur ne of 552 hours fo	mulative recovery or SI-4B and 356.	<u>/</u>	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	nly graphic showing reco otal Boiler operation tim	overy rate and cur ne of 552 hours fo	mulative recovery r SI-4B and 356.	<u>/</u> 5 for SI-1.	Boilers only r
from recovery	data and that was on h many at 4 hours. T	nly graphic showing reco otal Boiler operation tim	overy rate and cur ne of 552 hours fo	nulative recovery or SI-4B and 356.	/ 5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	aly graphic showing reco	overy rate and cur ne of 552 hours fo	nulative recovery or SI-4B and 356.	<u>/</u> 5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	nly graphic showing reco otal Boiler operation tim	overy rate and cur ne of 552 hours fo	nulative recovery or SI-4B and 356.	5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	oly graphic showing rectional Boiler operation tin	overy rate and cur ne of 552 hours fo	nulative recovery r SI-4B and 356.	/ 5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	aly graphic showing rectional Boiler operation tim	overy rate and cur ne of 552 hours fo	nulative recovery r SI-4B and 356.	/ 5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	aly graphic showing rectional Boiler operation tim	overy rate and cur ne of 552 hours fo	nulative recovery r SI-4B and 356.	/ 5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	aly graphic showing reco otal Boiler operation tim	overy rate and cur ne of 552 hours fo	nulative recovery r SI-4B and 356.	/ 5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	aly graphic showing reco	overy rate and cur ne of 552 hours fo	nulative recovery r SI-4B and 356.	/ 5 for SI-1.	Boilers only r
from recovery 10/hrs/day with	data and that was on h many at 4 hours. T	oly graphic showing rect otal Boiler operation tim	overy rate and cur ne of 552 hours fo	nulative recovery r SI-4B and 356.	5 for SI-1.	Boilers only r
from recovery 10/hrs/day with Lessons Learned	h many at 4 hours. T	otal Boiler operation tim	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1.	«Whr/yd³
from recovery 10/hrs/day with Lessons Learned	tal energy applied to	otal Boiler operation tim	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1. 3 k kWhr/m ³	kWhr/yd³
from recovery 10/hrs/day with Lessons Learned	tal energy applied to the energy:	treatment zone:	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1.	kWhr/yd ³ kWhr/y
from recovery 10/hrs/day with Lessons Learned	tal energy applied to the energy:	otal Boiler operation tim	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1. 3 k kWhr/m ³	kWhr/yd ³ kWhr/y
from recovery 10/hrs/day with Lessons Learned	tal energy applied to the energy:	treatment zone:	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1. 3 k kWhr/m ³	kWhr/yd ³ kWhr/y
Energy Total Energy Used: Cost	tal energy applied to the energy:	treatment zone:	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1. 3 k kWhr/m ³	kWhr/yd ³ kWhr/y
Energy Total Energy Used: Cost Total Project Cost:	tal energy applied to ener energy: Please	treatment zone:	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1. 3 k kWhr/m ³	kWhr/yd ³ kWhr/y
from recovery 10/hrs/day witl Lessons Learned	tal energy applied to the energy: Please	treatment zone:	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1. 3 k kWhr/m ³	kWhr/yd³
Energy Total Energy Used: Cost Total Project Cost: Co The	tal energy applied to her energy: Please nsultant Cost: ermal Vendor Cost:	treatment zone:	ne of 552 hours fo	kWhr/m	3 k kWhr/m ³ kWhr/m ³	kWhr/yd ³ kWhr/y
Energy Total Energy Used: Cost Total Project Cost: Co The	tal energy applied to the energy: Please Insultant Cost: Ermal Vendor Cost: Ergy Cost:	treatment zone:	ne of 552 hours fo	r SI-4B and 356.	5 for SI-1. 3 k kWhr/m ³	kWhr/yd³
Energy Total Energy Used: Cost Total Project Cost: Co The	tal energy applied to the energy: Please nsultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1:	treatment zone:	ne of 552 hours fo	kWhr/m	3 k kWhr/m ³ kWhr/m ³	kWhr/yd³
Energy Total Energy Used: Cost Total Project Cost: Co The Co Cot Cot Cot Cot Cot Cot Cot Cot Cot	tal energy applied to there energy: Please nsultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1: her Cost 2:	treatment zone:	ne of 552 hours fo	kWhr/m	3 k kWhr/m ³ kWhr/m ³	
Energy Total Energy Used: Cost Total Project Cost: Co The Co Cot Cot Cot Cot Cot Cot Cot Cot Cot	tal energy applied to the energy: Please nsultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1:	treatment zone:	ne of 552 hours fo	kWhr/m	3 k kWhr/m ³ kWhr/m ³	«Whr/yd³ kWhr/y
Energy Total Energy Used: Cost Total Project Cost: Co The Co Cot Cot Cot Cot Cot Cot Cot Cot Cot	tal energy applied to the energy: Please Insultant Cost: Ermal Vendor Cost: Ergy Cost: Ergy Cost: Ergy Cost: Ergy Cost: Ergy Cost: Ergy Cost 1: Ergy Cost 2: Ergy Cost 3:	treatment zone:	ne of 552 hours fo	kWhr/m	3 k kWhr/m ³ kWhr/m ³	«Whr/yd³ kWhr/y

___ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD				Date:	11/9/2006
	Type of treatment:	Conductive	X Steam	ERH	Other:		
	Type of Contaminant:	X Chlorinated Solv		X Petroleum Hydroc	arbons	Pesticides	
		Wood Treating		Other:			
	Treatment Status:	Active	<u>X</u> Post				
	Type of Test:	X Pilot Test	Full So	cale System			
	Start of Test:	5/28/2002	Е	nd of Test: 7/12/2002		Duration: 45 d	
	Type of Site:	Non-DOD	<u>X</u> DoD				
<u>X</u>	Facility Name: Edwards Address:	AFB					_
	City, State, Zip Code:	<u>California</u>					
	OU# or Site #: Site 61, O	<u>U-8</u>					
<u>X</u>	Primary point of contact:	Dr. Stephen Watts					
	Organization: <u>USAF</u>						
	Address: 95 ABW/CEVX	5 E. Popson A	Ave., Bldg. 265	<u>60a</u>			
	City, State, Zip Code:	Edwards AFB, CA 93	<u>3524</u>				
	Phone #: 661-277-1443		email: s	stephen.watts@edwards	.af.mil		
	Other contacts or vendors wl	ho worked on site		None			
	Point of contact:						
	Type: <u>X</u> Vendor, C	Consultant	_ Vendor, Tec	hnical Applications	Oth	er	
	Organization: <u>SteamTecl</u>	<u>h</u>					
	Address:						
	City, State, Zip Code:	Bakersfield CA no l	onger in busine	ess			
	Phone #:		email:				
Q.	A/QC						
	_ Characteristics of Interest						
	Good pre- and post-tre	eatment groundwater dat	a	Good pre- a	nd post-treatmen	nt soil data	
	Good temperature prof	file vs. time information		Flux assessr	nent		
	Groundwater elevation	ns		Geologic cre	oss-section		

0130

General Site Information

_____ Hydraulic Conductivity information

X	Impacted	Zone:	Impacted zone	ow direction)(ft.): 1025 as defined by documentation hod for determining size of in			cness (ft): 60		Unknown
			Map attachmer						
X	Monitor V	Vells:	Number of relevant	monitoring wells with ground	water data:				None
					Pre-treatment	nt: <u>3</u>	Post-treatment:	<u>3</u>	
			Number of wells rela	ative to treatment zone:					
			Pre-treatment	In: <u>3</u>	Upgradient:	_ Downgradient:	Cro	ssgradient:	
			Post-treatmen	t In: <u>3</u>	Upgradient:	_ Downgradient:	Cro	ssgradient:	
X	Soil Boring	js:	Number of relevant s	soil borings with pre-treatmen	it data:	<u>3</u>			
			Number of relevant s	soil borings with post-treatment	nt data:	<u>3</u>			
			Number inside treatn	nent zone: 3	Number outs	side treatment zone:	<u>3</u>		
X	Types of C	Contamina	nts						
							ent Concentration per nical:		ent Concentration per nical:
		CI	nlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		X Tric	chloroethene	Hexane	Creosote	1 mg/L	None	0.1 mg/L	None
		X Tet	rachloroethene	Jet Fuel		0.005 mg/L	None	0.001 mg/L	None
		<u>X</u> 1,1-	dichloroethene	Napthalene		0.005 mg/L	0.01 mg/kg	0.001 mg/L	None
		cis-	1,2-dichloroethene	X Benzene		0.01 mg/L	0.01 mg/kg	0.001 mg/L	None
		tran	s-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-	dichloroethane	Ethylbenzene		None	None	None	None
		1,2-	dichloroethane	m/p-xylene		None	None	None	None
	Chemicals of	1,1,	1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,	2-trichloroethane	X Benzene (deep)		0.005 mg/L	0.01 mg/kg	0.001 mg/L	None
		1,1,	2,2-tetrachloroethane			None	None	None	None
		Vin	yl Chloride			None	None	None	None
		X TC	E (deep)			1 mg/L	0.01 mg/kg	0.5 mg/L	None
		X PCI	E (deep)			0.01 mg/L	0.01 mg/kg	0.001 mg/L	None
		<u>X</u> <u>1-D</u>	CE (deep)			0.01 mg/L	0.01 mg/kg	0.001 mg/L	None
						None	None	None	None
						None	None	None	None
L						None	None	None	None
	Comme	<u> </u>		N concentrations for PCE, is from shallow interval, the before		eep" are from deeper in	terval of single grou		but were in fact all I deep soil were ND
							<u></u>		
	Attachmer	nts:							
		_							
		_							

0130

General Site Assessment Data

<u>X</u>	Geology:	Zone		Uncon	solidate	d Sedir	ments_					
		Vadose Zone) :	R	elatively	/ homo	geneous	and perme	able unce	onsolidated	sediments	
				R	elatively	/ homo	geneous	and impern	neable ur	nconsolidate	ed sediments	
				<u>X</u> La	argely p	ermeal	ble sedim	ents with in	nter-bedd	ed lenses o	f lower perme	ability material
				La	argely in	nperme	eable sed	liments with	n inter-be	dded layers	of higher peri	meability material
				c	ompete	nt, but	fractured	bedrock (i.e	e. crystal	line rock)		
				W	/eathere	ed bedr	ock, lime	stone, sand	dstone			
		Saturated Zo	ne:	R	elatively	/ homo	geneous	and perme	able unce	onsolidated	sediments	
							•	•			ed sediments	
							•	•				ability material
											•	meability material
					• •			bedrock (i.e		•	0 1	,
				_				stone, sand	•	,		
							,					
<u>X</u>	Ground surface e	elevation based on	wells in o	or adjace	nt to trea	atment	zone:	2335		ft amsl	_	Unknown
<u>X</u>	Aquifer Characte	ristics:										
	Is more than 1 ac	quifer present?	<u>X</u>	No		_ Ye	s (number)):			Unknown (ass	sume single aquifer)
				Aqı	uifer 1		Α	quifer 2		Aquifer 3		
	Depth to water:	low value (ft l	ogs):	<u>32</u>								
		high value (ft	bgs):	<u>33</u>							_	
		Unknown:									_	
<u>X</u>	Flow direction			Southea	<u>st</u>						_	
				0.044 re	ported, l	ikely						
<u>X</u>	•	ulic gradient (feet/fo	•	much le	<u>88</u>							Unknown
	Vertical hydraulic	gradient (feet/foot)	:	none								Unknown
.,		_				٠.						
<u>X</u>	K range (ft/day)		leasured	•	<u>X</u>	Slug	Test	La	aboratory		Field da	
			w	0.32								Unknown
			igh	<u>1</u>		٠.						
	Transmissivity (ft		leasured			_ Slug	Test	La	aboratory		Field da	
			w	31.32								Unknown
		hi	igh	<u>97.3</u>							_	
	Comments:											
		0.007: 5:5										
	A	S=0.007 to 0.05										
	Attachments:											

The	rmal Treatment - Design								Fac	ility ID#:	<u>0130</u>	
<u>X</u>	Thermal treatment:		_ Conductiv	/e								
			_ Electrical	Resistance								
				_ 3 phase		6 phase		_AC powe	r	DC	power	
		<u>X</u>	Steam									
				Steam		Steam + air		_ Steam + 0	D2			
V	Turns of Toots V	D:1	Other (de		1. (•
<u>X</u>	Type of Test: X	Pilot		Full-			acabla un	oonaalidat	ad aad	limonto		
<u>X</u>	Geology of Treatment Zone	e:				geneous and perm						
			·			ogeneous and impe ble sediments with					hility material	
						eable sediments w					-	ı
			X			fractured bedrock				ligher penn	leability materi	aı
			Δ	•		rock, limestone, sa		amine rock	,			
<u>X</u>	Treatment Targe Zone:		Saturate			Vadose only	<u>X</u>	Both (Sat	urated :	and Vadose	zones)	
<u>X</u>	Start of Thermal Test:	5/8/2		,		-	ion: 45 d					
<u>X</u>	Hydraulic Control	X	Yes	No								
	·											
<u>X</u>	Treatment Cell Design:											
	Size of target zone (ft2):				<u>90</u>			Un	known	(x fi	t)
	Thickness of target zone (f	t):			<u>55</u>			Un	known			
	Depth to top of target zone	(ft bg	ıs):		<u>5</u>			Un	known			
	Thickness of target zone be	elow v	water table	(ft):	<u>28</u>			Un	known			
	Number of energy delivery	points	s:		<u>1</u>			Un	known			
	Number of extraction points	s:			<u>4</u>			Un	known			
<u>x</u>	Temperature Profile:											
	Initial formation temperatur	e (de	g C):			<u>20</u>				_ Unknown		
	Maximum representative for	ormati	on temper	ature (deg C	;):	<u>100</u>				_ Unknown		
	Time to reach maximum re	prese	ntative ten	nperature (da	ays):	44				Unknown		
	Duration of treatment at rep	presei	ntative tem	perature (da	ays):	<u>1</u>				_ Unknown		
							Date		7	Гетрегаtur	e (dea C)	
	Formation temperature imr	nedia	tely post-tr	eatment:		7/12/2002			<u>95</u>			
	Formation temperature pos				t 1:	8/5/2002			80			
	Duration of post-treatment	monit	oring (day	s):		<u>~25</u>						
<u>X</u>	Mass of contaminant remo	ved:										
_			pumping:			<u><1.81</u>		lb	<u>X</u>	kg	Unkno	ow
		•	tream:			1234		_	<u>_</u>	kg	Unkno	
	Tota					1342			X	kg	Unkno)W
	Comments:											
												_
	Attachments:											_
												_

0130 Cost and Performance Facility ID#: Performance X Remediation Goal: In Groundwater: 1) Quantify mass reduction of TCE and other COCs: 2) Characterize steam movement: 3) Document operation and maintenance with regards to reliability and cost. In Soil: Was the Remediation Goal Achieved: In Groundwater Comment: Traction of total recovery. Steam heating plus vapor phase extraction yielded most of the remaining recovery. _ In Soil Comment: General comments on the thermal application: Objective: Determine if steam is an effective technology to remove TCE and other COCs from fractured bedrock at Site 61. Steam was judged very effective. High capital cost of full scale system made USAF reluctant to scale up, although complete cleanup of plume could probably have been achieved in a short time making life-cycle cost favorable. Lessons Learned Initial plan and funding for 30_day pilot test was insufficient for technology Energy _ kWhr/yd³ ___ kWhr/m³ Total Energy Used: ___ kWhr 109901 kw-hr Total energy applied to treatment zone: _ kWhr/yd³ Other energy: 33703 ke-hr kWhr/m³ _ kWhr/yd³ extracted water-115x10E6 BTUs (30% of injected energy) Total Please note other energy: energy - 375x10E6 BTUs <u>X</u> Cost Total Project Cost: 525,000 __ Consultant Cost: __ Thermal Vendor Cost: ___ Energy Cost: Other Cost 1: _ Other Cost 2:

___ Other Cost 3:

Other Cost 1:
Other Cost 2:
Other Cost 3:

Please note other cost:

x File Analyzed By: JT	<u>x</u>	PD						Date:	10/30/2006
Type of treatment:		Conductive		Steam	<u>x</u>	ERH	Other:		
Type of Contaminant:	_	Chlorinated Sol	lvents	_	Petr	oleum Hydroc	arbons	Pesticid	es
	_	Wood Treating			Oth	er:			
Treatment Status:	_	Active	<u>x</u>	Post					
Type of Test:	<u>x</u>	Pilot Test		Full Scale	e Syste	m			
Start of Test:				End	of Tes	t:		_ Duration:	
Type of Site:	<u>x</u>	Non-DOD	_	DoD					
<u>×</u> Facility Name: <u>Former A</u>	Agricul	tural Products							
Address:									
City, State, Zip Code:	Nev	wark, CA							
OU# or Site #:									
Primary point of contact:	Bill	Heath							
Organization: <u>CES</u>									
Address: 419 W. Entiat	St								
City, State, Zip Code:	Ker	nnewick, WA 9933	<u>36</u>						
Phone #: 509-727-4276			•	email: bill@	@cesiw	eb.com			
Other contacts or vendors v	vho wo	orked on site				_ None			
Point of contact:									
Type: Vendor,	Consul	tant	Vend	lor, Techni	cal Ap	plications	Oth	ier	
Organization:									
Address:									
City, State, Zip Code:									
Phone #:				email:					
QA/QC									
Characteristics of Interes	it								
Good pre- and post-t	eatme	nt groundwater da	ta			_ Good pre- a	nd post-treatme	nt soil data	
Good temperature pr						Flux assessr	_		
Groundwater elevation						Geologic cr	oss-section		
Hydraulic Conductiv	ity info	ormation							

0140

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0140</u>
Impacted	= "	v direction)(ft.):		Thick	ness (ft):		Unknown
		•	pacted zone (See source zo	ne definition attachmer	uts)		
	Map attachment		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		,		
	map attachment						
Monitor V	Vells: Number of relevant m	nonitoring wells with ground	vater data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	ive to treatment zone:	i io doddione.		Tost treatment.		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				· ·		· —	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
		il borings with post-treatmer					
	Number inside treatme			treatment zone:			
			_				
Types of C	Contaminants						
//							
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	nts:						
Attachmer	nts:						
	-						-

Geology: Zone Unconsolidated Sediments	Hydrogeologic Concep	tual Model		Facility ID#:	0140
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, ilmestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fracturad bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: It amis! Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Aquifer 2 Aquifer 3 Depth to water: low value (it bgs): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (it bgs): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (it bgs): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (it bgs): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (it bgs): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (it bgs): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Laboratory Field data low Unknown bigh Depth Measured using: Slug Test Laboratory Field data low Unknown high Depth De	Geology:	Zone	<u>Unconsolidated Sediments</u>		
Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, Imestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl		Vadose Zone:	Relatively homogeneous and permeable unco	nsolidated sediments	
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): Unknown: Unknown: Unknown Horizontal hydraulic gradient (feet/foot): Unknown Weathered bedrock, limestone, sandstone Transmissivity (ft2/day) Measured using: Slug Test Laboratory Field data low Unknown high Unknown Laboratory Field data Laboratory Field data low Unknown high Unknown			Relatively homogeneous and impermeable un	consolidated sediments	
Competent, but fractured bedrock, linestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely permeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown high Slug Test Laboratory Field data low Unknown Measured using: Slug Test Laboratory Field data low Unknown high Unknown Lokanown Horizontal hydraulic gradient (feet/foot): Slug Test Laboratory Field data low Unknown Lokanown			Largely permeable sediments with inter-bedde	d lenses of lower permeability materi	al
Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number):			Largely impermeable sediments with inter-bed	ded layers of higher permeability mat	erial
Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded levers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1			Competent, but fractured bedrock (i.e. crystalli	ne rock)	
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Is more than 1 aquifer present? No Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Iow value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Iow high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Iow high Comments:			Weathered bedrock, limestone, sandstone		
Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Aquifer 2 Aquifer 3 Depth to water: Iow value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Weathered bedrock, limestone, sandstone ft amsl Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Iow value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Wertical hydraulic gradient (feet/foot): I Unknown Vertical hydraulic gradient (feet/foot): I Unknown I		Saturated Zone:	Relatively homogeneous and permeable unco	nsolidated sediments	
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl			Relatively homogeneous and impermeable un	consolidated sediments	
Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: If amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Iow value (it bgs): Injqh value (if bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): K range (ft/day) Measured using: Iow Inknown Slug Test Laboratory Field data Iow Inknown High Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Iow Unknown Luknown Luknown Field data Iow Unknown Luknown			Largely permeable sediments with inter-bedde	d lenses of lower permeability materi	al
Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1			Largely impermeable sediments with inter-bed	ded layers of higher permeability mat	erial
Ground surface elevation based on wells in or adjacent to treatment zone: fit ams1 Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 High value (ft bgs): High value (ft bgs): Unknown: Horizontal hydraulic gradient (feet/foot): Unknown Unknown Vertical hydraulic gradient (feet/foot): Unknown Field data Laboratory Field data Unknown high Field data Unknown Field data Unknown high Unknown Field data Unknown Field data			Competent, but fractured bedrock (i.e. crystalli	ne rock)	
			Weathered bedrock, limestone, sandstone		
Is more than 1 aquifer present?NoYes (number):Unknown (assume single aquifer) Aquifer 1	Ground surface e	elevation based on wells in	or adjacent to treatment zone:	it amsl Unknown	1
Is more than 1 aquifer present?NoYes (number):Unknown (assume single aquifer) Aquifer 1					
Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs):	Aquifer Characte	ristics:			
Depth to water: low value (ft bgs): high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown High Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Laboratory Measured using: Laboratory Field data Laboratory Measured using: Laboratory Field data Laboratory Measured using: Measur	Is more than 1 ac	quifer present?	No Yes (number):	Unknown (assume single aq	uifer)
high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Unknown Laboratory Field data Unknown high Comments:			Aquifer 1 Aquifer 2	Aquifer 3	
Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data low Unknown high Comments:	Depth to water:	low value (ft bgs):			
Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot):		high value (ft bgs):			
Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Comments:		Unknown:			
Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Comments:					
Vertical hydraulic gradient (feet/foot):	Flow direction				
Vertical hydraulic gradient (feet/foot):					
K range (ft/day) Measured using:Slug TestLaboratoryField data lowUnknown high Transmissivity (ft2/day): Measured using:Slug TestLaboratoryField data lowUnknown highUnknown Comments:	-				
low	Vertical hydraulic	gradient (feet/foot):		Unknown	1
low					
high	K range (ft/day)		d using: Slug lest Laboratory		
Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Comments:				Unknown	1
lowUnknown high Comments:	-	ŭ			
high	Transmissivity (ft		d using: Slug lest Laboratory	<u> </u>	
Comments:				Unknown	1
		high			
	0				
Attachments:	Comments:				
Attachments:					
Attachments:	Aussl				
	Attachments:				

The	rmal Treatment - Design							Fa	acility ID#:	<u>0140</u>
<u>x</u>	Thermal treatment:		_ Conductive	:						
_		x	Electrical F							
				3 phase	_	6 phase		AC power	DC	power
			Steam							
				Steam	_	Steam + air		Steam + O2		
			Other (desc	ribe)						
<u>x</u>	Type of Test: <u>x</u>	Pilot	test	Full-	scale Syst	em				
	_ Geology of Treatment Zone	e:	-	-	_	neous and perme				
			-	•	•	neous and imper				
						sediments with i			-	-
									f higher perr	neability material
				-		ctured bedrock (i	-	ine rock)		
				=		k, limestone, san				
-	_ Treatment Targe Zone:		_ Saturated	only	Va	-		Both (Saturated		
	_ Start of Thermal Test:					Duratio	on:			
	_ Hydraulic Control		Yes	No						
	Treatment Cell Design:									
	_ Treatment Cell Design:							17.1		- 60
	Size of target zone (ft2):	٠١.						Unknow		_ x ft)
	Thickness of target zone (ff Depth to top of target zone		c).		-			Unknow Unknow		
	Thickness of target zone be		•	ft\·				Unknow		
	Number of energy delivery			11.).				Unknow		
	Number of extraction points	-					_	Unknow		
	Number of extraction points	o.						Clikilow	11	
	_ Temperature Profile:									
-	Initial formation temperature	e (dec	ı C).						Unknowr	ı
	Maximum representative for			ure (dea C)):				Unknowr	
	Time to reach maximum re		-						Unknowr	
	Duration of treatment at rep								Unknowr	
					,,-,.					
						D	ate		Temperatu	re (deg C)
	Formation temperature imn	nediat	ely post-tre	atment:						
	Formation temperature pos	t-trea	tment monit	oring event	1:					
	Duration of post-treatment	monit	oring (days)	:						
	_ Mass of contaminant remov	ved:								
	Via I	iquid	pumping:				1	b	kg	Unknown
	In va	por s	tream:				1	b	kg	Unknown
	Tota	l:					1	b	kg	Unknown
	Comments:									
	Attachments:									

and Performance					Facility ID#:	<u>0140</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	In Soil:					
	<u> </u>					
Was the Remediation						
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Whr/vd ³
	tal energy applied to t	reatment zone:			kWhr/m³	kWhr/yc
	her energy:				_ kWhr/m³	kWhr/yo
					_ KVVIII/III	KVVIII/yC
	Please	note other energy:	-			
Cost						
Total Project Cost:						
-	nsultant Cost:					
	ermal Vendor Cost:					
	ergy Cost:			m ³	_ yd³	
	her Cost 1:				_ yu	
	her Cost 2:					
	her Cost 3:	Oth 0				
Please note of	tner cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

General Site Information Facility ID#: 0145 File Analyzed By: PD ____ Date: 11/15/2006 ____Other: Type of treatment: _Conductive Steam ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___Wood Treating Other: Treatment Status: _Active Post Type of Test: Pilot Test Full Scale System Start of Test: 6/19/2003 End of Test: 3/17/2004 Duration: 270 d Type of Site: Non-DOD __ DoD Facility Name: Guadalupe Address: City, State, Zip Code: Guadalupe, CA OU# or Site #: Primary point of contact: Paul Johnson Organization: Arizona State University Address: City, State, Zip Code: Phone #: 480-965-1730 email: paul.c.johnson@asu.edu Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: Vendor, Consultant ____ Other Organization: Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

Ge	neral Site Ass	sessment Data					Facility I	D#: <u>0145</u>
<u>x</u>	Impacted 2	Zone: Length (parallel to fle	ow direction)(ft.): 2000	Width (ft):	<u>2000</u> Thi	ckness (ft): 1:	<u>5</u>	Unknown
		Impacted zone	as defined by documentation	1				
		Alternative me	thod for determining size of in	npacted zone (See source a	zone definition attachm	ents)		
		Map attachme	nt					
<u>x</u>	Monitor W	/ells: Number of relevant	monitoring wells with ground	water data:				None
				Pre-treatment	t: <u>4</u>	Post-treatment:	<u>4</u>	
		Number of wells rel	ative to treatment zone:					
		Pre-treatmen	t In: <u>4</u>	Upgradient:	Downgradient	:: C	rossgradient:	
		Post-treatmer	nt In: <u>4</u>	Upgradient:	Downgradient	: C	ossgradient:	
<u>x</u>	Soil Boring	s: Number of relevant	soil borings with pre-treatmen	t data: <u>10</u>	<u>)</u>			
		Number of relevant	soil borings with post-treatmen	nt data: 12	<u>!</u>			
		Number inside treati	ment zone: 10	Number outsid	de treatment zone:	<u>12</u>		
<u>x</u>	Types of C	ontaminants	T		1			
						ment Concentration per emical:		nent Concentration per mical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	o-xylene		None	None	None	None
С	hemicals of Concern	1,1,2-trichloroethane	x TPH (leachate)		10 mg/L	None	5 mg/L	None
		1,1,2,2-tetrachloroethane	x PAH (leachate)		0.05 mg/L	None	0.005 mg/L	None
		Vinyl Chloride	x BTEX (leachate)		0.01 mg/L	None	0.001 mg/L	None
			x TPH		5 mg/L	None	5 mg/L	None
			x PAH		0.01 mg/L	None	0.005 mg/L	None
			x BTEX		0.01 mg/L	None	0.001 mg/L	None
			x <u>Diluent</u>		None	10,000 mg/kg	None	10,000 mg/kg
					None	None	None	None
					None	None	None	None
	Comme	nts:	<u>Dilu</u>	ent - Pre-treatment conc			uene, Ethylbenzene, a	nd m-, o-, p-xylene:
	Attachmen	ts:						

<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sediments								
		Vadose Zone:	\underline{x} Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated sediments								
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			Largely impermeable sediments with inter-bedded layers of higher permeability material								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	x Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated sediments								
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			Largely impermeable sediments with inter-bedded layers of higher permeability material								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
<u>x</u>	Ground surface	elevation based on wells in	or adjacent to treatment zone: 50 ft amsl Unknown								
<u>x</u>	Aquifer Characte	eristics:									
	Is more than 1 a	quifer present?	No Yes (number): X Unknown (assume single aquifer)								
			Aquifer 1 Aquifer 2 Aquifer 3								
	Depth to water:	low value (ft bgs):	55								
		high value (ft bgs):	60								
		Unknown:									
<u>x</u>	Flow direction		<u>W</u>								
<u>x</u>	Horizontal hydra	ulic gradient (feet/foot):	0.003 to 0.004 Unknown								
	Vertical hydraulic	gradient (feet/foot):	Unknown								
<u>x</u>	K range (ft/day)	Measure	ed using: Slug Test Laboratory Field data								
		low	75Unknown								
		high									
	Transmissivity (f	t2/day): Measure	ed using: Slug Test Laboratory Field data								
		low	Unknown								
		high									
		_									
	Comments:										
		Porosity - 0.4	Velocity - 1 ft/day								
	Attachments:										

The	rmal Treatment - Design							F	acility ID#:	<u>0145</u>
<u>x</u>	Thermal treatment:		_ Cond	uctive _						
			_ Electi	rical Resistance	·					
		<u>x</u>	Steam	3 phase		6 phase		_AC power	DC	power
		_	Other	Steam (describe)	x	Steam + air		_ Steam + O2		
<u>x</u>	Type of Test: <u>x</u>	Pilo	t test		ull-scale Syste	-m				
<u>x</u>	Geology of Treatment Zor		t test	<u></u>	-	neous and perme	eable un	consolidated s	ediments	
_				_	-	eous and imper				
					-	sediments with i				ability material
					•				-	neability material
						ctured bedrock (i			g p	,
						, limestone, san	-			
<u>x</u>	Treatment Targe Zone:		Satu	rated only		dose only	<u>x</u>	Both (Saturate	d and Vadose	zones)
<u>x</u>	Start of Thermal Test:	6/19	0/2003			•	n: 270			
<u>x</u>	Hydraulic Control	<u>X</u>	Yes	N	· 0	2 4.4	270	<u>=</u>		
_	,	_								
<u>x</u>	Treatment Cell Design:									
_	Size of target zone (ft2):				4900			Unknow	/n (70 x 70 ft)
	Thickness of target zone	(ft):			12			Unknow	-	
	Depth to top of target zon		as):		50			Unknow		
	Thickness of target zone		-	able (ft):	<u></u>			Unknow		
	Number of energy deliver			. ,	<u>4</u>			Unknow		
	Number of extraction poir				<u> </u>			Unknow		
	_Temperature Profile:									
	Initial formation temperate	ıre (de	g C):						Unknown	l
	Maximum representative	format	ion tem	perature (deg	j C):				Unknown	l
	Time to reach maximum r	eprese	entative	temperature	(days):				Unknown	L
	Duration of treatment at re	eprese	ntative	temperature ((days):				Unknown	L
						<u>D</u>	<u>Date</u>		Temperatu	re (deg C)
	Formation temperature im	media	itely po	st-treatment:						
	Formation temperature po	st-trea	atment	monitoring ev	ent 1:					
	Duration of post-treatmen	t moni	toring (days):						
<u>x</u>	Mass of contaminant rem	oved:								
	Via	liquid	pumpii	ng:	23000	gallons		lb	kg_	Unknown
	ln v	apor :	stream:		1850	gallons		_lb	<u>kg</u>	Unknown
	То	tal:			24850	gallons		_ lb	kg	Unknown
	Comments: Steam i	njectio	on Bea	an on 10/22/	03 and end	led on 3/17/04	so 145	days of steam	n injection.	The other days
						sure was cycle	d after s	steam breakth		
						Injection v	vell spac	cing - 34.5 ft		
	Attachments:									
										

Cost and Performance			Facility ID#:	<u>0145</u>
Performance				
Remediation Goal:				
In Gro	undwater:			
In Soil	:			
Was the Remediation Goal A	.chieved:			
In Gro				
(Comment:			
In Soil				
(Comment:			
General comments on the the	ermal application:			
Objective questions: 1)	What is optimum design and open	ating condictions? 2) What are improvements to gro	undwater quality?
3) What will remaining	be the diluent saturation and comp			
environmental impacts?	<u>, </u>			
Objective answers: 1)	Targe tempeature of a minimum of e well injecting more than 40% of a	100C 2) Minimum	of equivalent 2 targe treatment 2	zone pore volumes
collection to satisfy the		cumulative steam	of water mass balance is establi	Siled 4) Data
Lessons Learned				
Energy				
Total Energy Used:		kWhr	kWhr/m ³ kW	/hr/yd ³
Total energy	applied to treatment zone:		kWhr/m ³	kWhr/yd ³
Other energ			kWhr/m ³	kWhr/yd ³
·	Please note other energy:			
Cost				
Total Project Cost:				
Consultant (Cost:			
Thermal Ver	ndor Cost:			
Energy Cos	t:		yd³	
Other Cost	1:			
Other Cost 2	2:			
Other Cost 3	3:			
Please note other cost:	Other Cost 1:			
	Other Cost 2:			

____ Other Cost 3:

General Site Information Facility ID#: 0150 <u>X</u> PD ____ File Analyzed By: Date: 4/11/2005 Type of treatment: ____Conductive <u>X</u> Steam ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents X Petroleum Hydrocarbons ____ Wood Treating Other: Treatment Status: ____ Active Post X Type of Test: ____ Pilot Test X Full Scale System Start of Test: Nov-92 End of Test: Dec-93 Duration: 21 weeks Type of Site: ____Non-DOD DoD <u>X</u> Facility Name: <u>Lawrence Livermore National Laboratory (LLNL)</u> Address: City, State, Zip Code: California OU# or Site #: Gas Pad Primary point of contact: Roger Aines Organization: Address: City, State, Zip Code: Livermore, CA Phone #: 923-423-7184 email: aines1@llnl.gov Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: Address: City, State, Zip Code: Phone #: email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

Ge	neral Site As	sessment	Data					Facility I	D#:	0150
<u>x</u>	Impacted	Zone:	Length (parallel to flo	w direction)(ft.):	Width (ft):	Thickr	ness (ft):		<u>X</u>	Unknown
			Impacted zone	as defined by documentation	า					
			Alternative meth	nod for determining size of in	npacted zone (See source zo	one definition attachment	ts)			
			Map attachmen	t						
<u>X</u>	Monitor V	Vells:	Number of relevant r	monitoring wells with ground	water data:				_	None
					Pre-treatment:	<u>14</u>	Post-treatment:	<u>12</u>		
			Number of wells rela	tive to treatment zone:						
			Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
			Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
<u>X</u>	Soil Boring	gs:	Number of relevant so	oil borings with pre-treatmen	t data: 47					
			Number of relevant so	oil borings with post-treatmen	nt data: 26					
			Number inside treatm	nent zone:	Number outsid	e treatment zone:				
X	Types of C	Contaminar	nts							
						Average Pre-treatmer		Average Post-treatn Che	nent Co	
		Ch	lorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)
			hloroethene	Hexane	Creosote	None	None	None		None
	Ter		achloroethene	Jet Fuel		None	None	None		None
			dichloroethene	Napthalene		None	None	None		None
		cis-	1,2-dichloroethene	X Benzene		5 mg/L	None	0.1 mg/L		None
		trans	s-1,2-dichloroethene	X Tolune		1 mg/L	None	0.1 mg/L		None
			dichloroethane	X Ethylbenzene		1 mg/L	None	0.005 mg/L		None
			dichloroethane	m/p-xylene		0.1 mg/L	None	0.001 mg/L		None
			1-trichloroethane	o-xylene		None	None	None		None
	hemicals of Concern	1,1,2	2-trichloroethane	X Xylenes		5 mg/L	None	0.5 mg/L		None
	001100111	1,1,3	2,2-tetrachloroethane			None	None	None		None
			yl Chloride			None	None	None		None
			,			None	None	None		None
						None	None	None		None
						None	None	None		None
						None	None	None		None
						None	None	None		None
						None	None	None		None
_						Tione	110110	110110		110110
	Comme	nts:	1,2-DCA post trea	ntment concentration was I	ND. Average post treatm	ent concentrations bas	ed on 9/1/94 analys	is. Estimated spill o	f 620(0 gallons.
	Attachmer	nts:								
		_								
		_								
										,

<u>X</u>	Geology:	<u>Zone</u>	U	nconsolidated Sed	<u>iments</u>						
		Vadose Zon	ie:	Relatively home	ogeneous an	d permeable	unconsolidated sedi	ments			
				Relatively home	ogeneous an	d impermeab	le unconsolidated se	ediments			
			<u>X</u>	Largely permea	able sedimen	ts with inter-b	edded lenses of low	er permeability material			
				Largely imperm	neable sedim	ents with inter	r-bedded layers of h	igher permeability material			
				Competent, but	t fractured be	edrock (i.e. cry	stalline rock)				
				Weathered bed	drock, limesto	one, sandston	e				
		Saturated Z	one:	Relatively homogeneous and permeable unconsolidated sediments							
				Relatively hom	ogeneous ar	d impermeab	le unconsolidated se	ediments			
			<u>X</u>	X Largely permeable sediments with inter-bedded lenses of lower permeability material							
				Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock)							
				Weathered bed	drock, limesto	one, sandston	e				
<u>X</u>	Ground surface	elevation based on	wells in or ac	djacent to treatmen	nt zone:	640	ft amsl	Unknown			
<u>X</u>	Aquifer Charact	eristics:									
	Is more than 1 a	aquifer present?	No	Y	es (number):		<u>X</u> Unl	known (assume single aquifer)			
				Aquifer 1	Aqu	ifer 2	Aquifer 3				
	Depth to water:	low value (ft	bgs): <u>10</u>	<u>0</u>							
		high value (t	ft bgs): <u>12</u>	<u>0</u>							
		Unknown:									
<u>X</u>	Flow direction		W	<u>est</u>							
	Horizontal hydra	aulic gradient (feet/f	oot): <u>0.0</u>	0095				Unknown			
	Vertical hydraul	ic gradient (feet/foo	t):					Unknown			
<u>X</u>	K range (ft/day)	1	Measured usi	ng: Slu	g Test	Laborat	tory	_ Field data			
		I	ow <u>4 ι</u>	units with differing K	<u> </u>			Unknown			
		ŀ	nigh <u>sec</u>	e below							
	Transmissivity (ft2/day):	Measured usi	ng: Slu	g Test	Laborat	tory	_ Field data			
		I	ow					Unknown			
		ŀ	nigh								
	Comments:	A) Is talk as a survey like	996 10 1	- 0.1- 4.40 (1/1	(07.4)	0) (Sanda de Sada an anno and	. 926 l			
		1) high permeab		nels - 2 to 143 ft/day (avg. 37.4). 2) relatively high permeability channels - 1.74 to 3) moderate permeability - 2.14 to 22.7 ft/day (avg. 15.5). 4) low permeability -							
		<0.67 to 2.4 ft/da									
	Attachments:										

The	rmal Treatment - D	esign										Fa	acility ID#	: 0150	<u>)</u>
<u>X</u>	Thermal treatmen	nt:		_ Cond	uctive										
				Electi	rical Resis	tance									
					3 p	hase		_ 6 pha	se		_ AC p	ower		DC power	
			<u>X</u>	Stean	n <u>wit</u>	h electro	odes .								
					Ste	am		Stean	n + air		_ Steam	n + O2			
				_ Other	(describe)									
<u>X</u>	Type of Test:		_ Pilo	t test	<u>X</u>	Full-	scale Syster	m							
<u>X</u>	Geology of Treat	ment Zon	ie:		Re	latively	homogene	eous ar	d permeat	ole ur	nconsol	idated s	ediments		
					Re	latively	homogene	eous ar	id imperme	able	uncons	olidated	l sedimen	its	
					X La	rgely pe	ermeable s	edimer	its with inte	er-bed	dded le	nses of I	ower per	meability r	naterial
					La	rgely in	npermeable	e sedim	ents with i	nter-k	edded	layers o	f higher p	ermeabilit	ty material
					Co	mpeter	nt, but fract	ured be	edrock (i.e.	crys	talline r	ock)			
					We	eathere	d bedrock,	limesto	one, sands	tone					
<u>X</u>	Treatment Targe	Zone:		_ Satu	rated only	/	Vad	lose only	y	<u>X</u>	Both	(Saturate	d and Vad	ose zones)	
<u>X</u>	Start of Thermal	Test:	Nov	<u>-92</u>					Duration:	21 v	veeks				
<u>X</u>	Hydraulic Contro	I	<u>X</u>	Yes		No									
<u>X</u>	Treatment Cell D	-													
	Size of target zor						11304				-	Unknow		<u>120</u> x	<u>80</u> ft)
	Thickness of targ						<u>80</u>					Unknow			
	Depth to top of ta	_					<u>60</u>					Unknow			
	Thickness of targ				able (ft):		<u>30</u>					Unknow			
	Number of energ		-	is:			9					Unknow			
	Number of extrac	ction point	ts:				<u>3</u>				-	Unknow	'n		
<u>X</u>	Temperature Pro	file:													
^	Initial formation to		re (de	a C).				23					Unkno	own	
	Maximum repres				perature	(dea C).	100				_	Unkno		
	Time to reach ma							21				_	Unkne		
	Duration of treatr				•	,	• •	15				_	Unkno		
	Daration of trout		.р. оос		tompora		., 0,.	10				_		,	
									Date	<u> </u>			Temper	ature (deg	<u>(C)</u>
	Formation tempe	rature im	media	itely po	st-treatm	ent:						_			
	Formation tempe	rature po	st-trea	atment	monitorin	ig even	t 1:					_		_	
	Duration of post-	treatment	moni	toring (days):							_			
<u>X</u>	Mass of contamin	nant remo	oved:												
		Via	liquid	pumpi	ng:		1000	gal			_ lb	_	kg		Unknow
		In v	apor	stream:			6600	gal			_ lb	_	kg		_ Unknow
		Tota	al:				<u>7600</u>	gal		-	_ lb	_	kg		_ Unknow
	Comments:	_		_									_		
		Energy of occurred					electric he . Timino		and 3 elec 12 to 7/93						
		3/11/93.		_			93 to 6/30								
	Attachments:														

Cos	t and Performance					Facility ID#:	<u>0150</u>
<u>X</u>	Performance						
	Remediation Goal:						
	Х	In Groundwater:					
	=		MCLs: 1.2-DCA	· 1 ug/L; xylene - 1750	0 ua/l·toluene -	100 ug/L: benz	rene - 1 ua/l
		_ In Soil:		. ug/ <u>2, // / / / / / / / / / / / / / / / / / </u>	s agra, totaono		<u></u>
		<u>.</u> co					
	Was the Remediation	Goal Achieved:					
		_ In Groundwater					
		Comment:					
							_
		In Soil					
		Comment:					
		•					
	General comments or	n the thermal appli	cation:				
			20 deg C so zone always eam objective: Heat to s				
			quantify possible deleter		Junize monitorii	ig/control metri	ous, evaluate
	Lessons Learned						
							
							
	_ Energy						
	Total Energy Used:			kWhr	kWhr/m ³	kW	
	Tota	l energy applied to	treatment zone:			kWhr/m ³	kWhr/yd ³
	Othe	er energy:	_			kWhr/m ³	kWhr/yd ³
		Pleas	e note other energy:				
.,							
<u>X</u>	Cost						
	Total Project Cost:	<u>1</u>	10 per cubic yard				
	Cons	sultant Cost:					
	Ther	rmal Vendor Cost:					
	Ener	rgy Cost:			m ³	yd ³	
	Othe	er Cost 1:					
	Othe	er Cost 2:					
	Othe	er Cost 3:					
	Please note oth	er cost:	Other Cost 1:				
		•	Other Coet 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	9/13/2006
	Type of treatment:	x Conductive	Steam	ERH	Other:		
	Type of Contaminant:	Chlorinated Solv	vents	Petroleum Hydroca	bons	Pesticide	s
		Wood Treating	<u>x</u>	Other: PCBS			
	Treatment Status:	Active	<u>x</u> Post				
	Type of Test:	x Pilot Test	Full Scale	System			
	Start of Test:	10/11/1997	End	of Test: <u>11/17/1997</u>		Duration: 37	days
	Type of Site:	Non-DOD	<u>x</u> DoD				
<u>x</u>	Facility Name: Mare Islan	nd Naval Shipyard					
	Address: <u>Building 8</u>	866, junction of Suisun A	venue and Mesa	Road			
	City, State, Zip Code:	Vallejo, CA					
	OU# or Site #: Site 11						
<u>x</u>	Primary point of contact:	Ralph Baker					
	Organization: <u>TerraTherra</u>	<u>m</u>					
	Address: 10 Stevens Rd.						
	City, State, Zip Code:	Fitchburg, MA 01420					
	Phone #: 978-343-0300		email: <u>rba</u>	ker@terratherm.com			
<u>x</u>	Other contacts or vendors wh	ho worked on site		None			
	Point of contact: Rich	nard Faris					
	Type: Vendor, C	onsultant	_ Vendor, Techni	cal Applications	<u>x</u> Oth	er <u>client</u>	
	Organization: <u>EFA West</u>	, NAVFAC (U.S. Navy)					
	Address: 900 Commodore	e Drive, Code 182					
	City, State, Zip Code:	San Bruno, CA 94066					
	Phone #: 650-244-22704		email: <u>jrfa</u>	ris@efawest.navfac.na	vy.mil		
Q/	A/QC						
<u>x</u>	Characteristics of Interest						
	Good pre- and post-tre	atment groundwater data	a	x Good pre- and	l post-treatmer	nt soil data	
	<u>x</u> Good temperature prof	file vs. time information		Flux assessme	ent		
	Groundwater elevation	ns		Geologic cros	s-section		
	Hydraulic Conductivit	y information					

0160

General Site Information

General Site As	sessment Data					Facility I	D#: <u>0160</u>
x Impacted	Zone: Length (parallel to flow	w direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u> Unknown
= '		as defined by documentation					
	 -		npacted zone (See source zo	one definition attachmer	nts)		
	Map attachment			one deminion diddennion	,		
	Map attachment	•					
<u>x</u> Monitor V	Vells: Number of relevant r	monitoring wells with ground	water data:				x None
<u>x</u> Worldon	voils.	nomening wens war ground	Pre-treatment:		Post-treatment:		<u>k</u> None
	Number of wells rela	tive to treatment zone:	The decidinent.		Tost treditions.		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment		Upgradient:	Downgradient:		ssgradient:	
	i ost-treatment		opgradient.	Downgradient.		ssgradient.	
x Soil Boring	no: Number of relevant or	oil borings with pre-treatmen	t data: 4 samme	ita			
x Soil Boring		oil borings with post-treatmen					
				e treatment zone:			
	Number inside treatin	ent zone: 4 composite	Number outside	e treatment zone.			
v Times of C	Santaminanta						
x Types of C	Contaminants						
					ent Concentration per		ent Concentration per
	CIL 1 . 10 I	D. 1 W. 1	0.1	Chen			nical:
	Chlorinated Solvents Trichloroethene	Petroleum Hydrocarbons Hexane	Other	Groundwater (mg/L) None	Soil (mg/kg) None	Groundwater (mg/L) None	Soil (mg/kg) None
	Tetrachloroethene		<u>Creosote</u>				
		Jet Fuel	x Arclor 1254	None	100 mg/kg	None	0.01 mg/kg
	1,1-dichloroethene	Napthalene	X Arclor 1260	None	10 mg/kg	None	0.01 mg/kg
	cis-1,2-dichloroethene	Benzene	x Total PCBs	None	100 mg/kg	None	0.01 mg/kg
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme		<u>S</u> ar	mples are composite samp	les at 0-1ft, 4-5 ft, 8-9) ft and 11-12 ft		
Attachmer	nts:						

Hydr	rogeologic Conceptual	Model		Facility ID#:	0160
<u>x</u>	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments x Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low at 4' Largely impermeable sediments with inter-bedded layers of h Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of h Competent, but fractured bedrock (i.e. crystalline rock) X Weathered bedrock, limestone, sandstone	eediments wer permeability material nigher permeability materi liments eediments wer permeability material	
<u>x</u>	Ground surface eleva	tion based on wells in o	r adjacent to treatment zone: 26 ft amsl	Unknown	
<u>X</u>	Aquifer Characteristic Is more than 1 aquifer Depth to water:		No Yes (number): X Unit Aquifer 1 Aquifer 2 Aquifer 3 9	known (assume single aquif	er)
<u>x</u>	Flow direction		<u> </u>		
<u>X</u>	Horizontal hydraulic g			<u>x</u> Unknown<u>x</u> Unknown	
<u>x</u>	K range (ft/day) Transmissivity (ft2/day	Measured low high Y): Measured low high	1(10^-5) cm/sec	Field data Unknown Field data Unknown	

Comments:

Attachments:

n~30%; moisture ~20%

Ther	rmal Treatment - Design					Facility ID#: 0160
<u>x</u>	Thermal treatment:	<u>x</u> Conductive				
		Electrical Resistan	ce			
		3 phas	se	6 phase	AC power	DC power
		Steam				
		Steam		Steam + air	Steam + O2	!
		Other (describe)				
<u>x</u>	Type of Test: \underline{x}	Pilot test	Full-scale Syste	em		
<u>x</u>	Geology of Treatment Zone	: Relati	ively homogen	eous and permea	ble unconsolidated	d sediments
		Relati	ively homogen	eous and imperm	eable unconsolida	ted sediments
		Large	ly permeable	sediments with int	er-bedded lenses	of lower permeability material
		<u>x</u> Large	ly impermeab	e sediments with	inter-bedded layer	s of higher permeability material
				tured bedrock (i.e		
				, limestone, sands	stone	
<u>X</u>	Treatment Targe Zone:	Saturated only	<u>x</u> Va	dose only		ated and Vadose zones)
<u>X</u>	Start of Thermal Test:	10/11/1997		Duration:	37 days	
<u>x</u>	Hydraulic Control	Yes <u>x</u>	No			
.,	Treatment Cell Design:					
<u>x</u>	Treatment Cell Design:		<u>323</u>		Unkn	own (x ft)
	Size of target zone (ft2): Thickness of target zone (ft	۸۰	<u>323</u> <u>14</u>		Unkn	·
	Depth to top of target zone		0.5		Unkn	
	Thickness of target zone be		<u>0</u>		Unkn	
	Number of energy delivery		12		Unkn	
	Number of extraction points		<u>12</u>		Unkn	
<u>x</u>	Temperature Profile:					
	Initial formation temperature	e (deg C):		<u>49</u>		Unknown
	Maximum representative fo	rmation temperature (de	eg C):	<u>410</u>		Unknown
	Time to reach maximum re	presentative temperatur	e (days):	<u>35</u>		Unknown
	Duration of treatment at rep	presentative temperature	e (days):	<u>2</u>		Unknown
				<u>Dat</u>	<u>e</u>	Temperature (deg C)
	Formation temperature imn					
	Formation temperature pos	_	event 1:			
	Duration of post-treatment	monitoring (days):				
	_ Mass of contaminant remov	ved.				
	_	iquid pumping:			lb	kg Unknown
		apor stream:			lb	kgUnknown
	Tota	•			lb	kgUnknown
	Comments:					
	Attachments:					

Cost and Performance Facility ID#: 0160

Performar	nce					
Remediati	ion Goal:					
	In Groundwate	r: 				
	x In Soil:					
		PCBs > 2mg/kg b	oy EPA regulations	, but site specific	at less than 1	mg/kg
Was the R	Remediation Goal Achieved:					
		er				
	Commen	t:				
	<u>s</u> In Soil					
	Commen	t:				
		yes all samples were belo	w 10 ug/kg			
General c	omments on the thermal ap	plication:				
		p				
Lessons L	aarnad					
	Learned					
Enormy						
Energy	ana da a da		1 33 71	1.14/1/ 3	1.1	NA/IL/I3
Total Ene			kWhr	kWhr/m ³		Whr/yd ³
	Total energy applied	to treatment zone:			_ kWhr/m ³	 ·
	Other energy:	_			_ kWhr/m ³	kWhr/yd ³
	Ple	ase note other energy:				
Cost						
Total Proje						
	Consultant Cost:					
	Thermal Vendor Cos	st:		0		
	Energy Cost:	-			_ yd³	
	Other Cost 1:					
	Other Cost 2:					
	Other Cost 3:					
Plea	se note other cost:	Other Cost 1:				
		Other Cost 2:				
		Other Cost 3:			- <u></u>	

File Analyzed By: <u>X</u> PD ____ Date: Type of treatment: ___ Conductive <u>X</u> Steam ERH Type of Contaminant: _ Chlorinated Solvents X Petroleum Hydrocarbons Pesticides ___ Wood Treating Other: Treatment Status: ____ Active Post X Type of Test: X Pilot Test Full Scale System Start of Test: 5/14/1999 End of Test: 7/24/1999 Duration: 70 d Type of Site: ___Non-DOD DoD <u>X</u> Facility Name: NAS Alameda Point Site 5 Steam Pilot City, State, Zip Code: Alameda, CA OU# or Site #: Site 5 Primary point of contact: Steven Peck Organization: Address: 1455 Frazee Rd., Ste. 900 City, State, Zip Code: San Diego, CA 92108 Phone #: 619-532-0756 email: steven.peck@navy.mil Other contacts or vendors who worked on site _None Point of contact: _____ Vendor, Technical Applications Type: Vendor, Consultant ____ Other Organization: Address: City, State, Zip Code: Phone #: email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0180

General Site Information

___ Hydraulic Conductivity information

X Impacted Zone: Length (parallel to flow direction)(ft.): 375 Width (ft): 215 Thickness (ft): Impacted zone as defined by documentation Alternative method for determining size of impacted zone (See source zone definition attachments) Map attachment											
X Monitor \	Wells: Number of relevant n	nonitoring wells with ground	water data:				None				
		Pre-treatment: 42 Post-treatment: 42									
	Number of wells relative to treatment zone:										
	Pre-treatment	In: <u>22</u>	Upgradient:	Downgradient:	Cros	ssgradient:					
Post-treatment In: 22 Upgradient: Downgradient: Crossgradient:											
X Soil Borin	ias: Number of relevant so	oil borings with pre-treatment	t data: <u>8</u>								
	=	Number of relevant soil borings with pre-treatment data: 8 Number of relevant soil borings with post-treatment data: 9									
	Number inside treatme	= .		treatment zone:							
X Types of	Contaminants	T	1	T-		1					
				Average Pre-treatme	ent Concentration per	Average Post-treatm	nent Concentration per				
					nical:		mical:				
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	Trichloroethene	Hexane	Creosote	None	None	None	None				
	Tetrachloroethene	Jet Fuel	X Trichloroethene - 7ft	50 mg/L	None	0.1 mg/L	0.01 mg/kg				
	1,1-dichloroethene	Napthalene	X Trichloroethene - 10ft	10 mg/L	None	0.05 mg/L	0.01 mg/kg				
	cis-1,2-dichloroethene	Benzene	X Trichloroethene - 13ft	0.1 mg/L	None	0.05 mg/L	0.01 mg/kg				
	trans-1,2-dichloroethene	Tolune	X <u>Tetrachloroethene-7ft</u>	0.5 mg/L	None	0.005 mg/L	0.01 mg/kg				
	1,1-dichloroethane	Ethylbenzene	X <u>Tetrachloroethene-10ft</u>	0.1 mg/L	None	0.001 mg/L	0.01 mg/kg				
	1,2-dichloroethane	m/p-xylene	X <u>Tetrachloroethene-13ft</u>	0.001 mg/L	None	0.001 mg/L	0.01 mg/kg				
Chemicals of	1,1,1-trichloroethane	o-xylene	X 1,1, TCA - 7ft	1 mg/L	None	0.005 mg/L	0.01 mg/kg				
Concern	1,1,2-trichloroethane		X 1,1, TCA - 10ft	0.5 mg/L	None	0.005 mg/L	0.01 mg/kg				
	1,1,2,2-tetrachloroethane		X 1,1, TCA - 13ft	0.001 mg/L	None	0.005 mg/L	0.01 mg/kg				
	Vinyl Chloride		X 1.1 DCA - 7ft	10 mg/L	None	0.01 mg/L	0.01 mg/kg				
			X 1.1 DCA - 10ft	1 mg/L	None	0.005 mg/L	0.01 mg/kg				
			X 1.1 DCA - 13ft	0.1 mg/L	None	0.001 mg/L	0.01 mg/kg				
			X cis 1,2 DCA - 7ft	10 mg/L	None	0.05 mg/L	0.01 mg/kg				
			X cis 1,2 DCA - 10ft	5 mg/L	None	0.01 mg/L	0.01 mg/kg				
			X cis 1,2 DCA - 13ft	1 mg/L	None	0.1 mg/L	0.01 mg/kg				
				None	None	None	None				
Comme	anta.										
Comme	erits.										
	Chemicals of interest: T	richloroethene (TCE), Teti	rachloroethene (PCE), 1,1	-Trichloroethane (1,1	TCA), 1,1-Dichloroe	ethane (1,1 DCA), cis	1,2-Dichloroethane				
(cis 1,2 DCA), Trimethylbenzene (TMB), and Naphthalene (Naph). All average post treatment soils concentrations were 0.005 mg/Kg but were listed as 0.0 mg/Kg due spreadsheet constraints.											
			mg/kg due spri	eadsneet constraints.	-						
Attachme	nto:										
Allacrime	ino.										

0180

General Site Assessment Data - Page 1

General Site Assessment Data - Page 2 Facility ID								D#: <u>0180</u>	
X Impacted	Zone: Length (parallel to flow	v direction)(ft.): 375		Width (ft):	215 Thic	kness (ft):		Unknown	
		is defined by documentation	ı						
	Alternative meth	od for determining size of in	npac	ted zone (See source z	one definition attachme	ents)			
	Map attachment	=		,		•			
X Monitor V	Vells: Number of relevant n	nonitoring wells with ground	wate	r data:				None	
<u>A</u> WOULD V	voils.	ioritoring wells with ground	vato	Pre-treatment:	42	Post-treatment:	<u>42</u>	None	
	Number of wells relat	ive to treatment zone:		Fie-treatment.	42	rost-treatment.	42		
				la ana di anti	D	0			
	Pre-treatment	In: <u>22</u>		Jpgradient:	Downgradient:	·	ssgradient:		
	Post-treatment	In: <u>22</u>	ι	Jpgradient:	Downgradient:	Cro	ssgradient:		
X Soil Boring	gs: Number of relevant so	il borings with pre-treatmen	dat	a: <u>8</u>					
	Number of relevant so	il borings with post-treatmen	nt da	ta: <u>9</u>					
	Number inside treatme	ent zone: <u>8, 9</u>		Number outsid	e treatment zone:				
Types of C	Contaminants								
					Aviana aa Bua tuaatuu	nent Concentration per	Avance Best treets	nent Concentration per	
						mical:		mical:	
_	Chlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane		Creosote	None	None	None	None	
	Tetrachloroethene	Jet Fuel	Χ	Trimethylbenzene-7ft	0.5 mg/L	None	0.01 mg/L	0.01 mg/kg	
	1,1-dichloroethene	Napthalene	X	Trimethylbenzene-10ft	0.5 mg/L	None	0.005 mg/L	0.01 mg/kg	
	cis-1,2-dichloroethene	Benzene	X	Trimethylbenzene-13ft	0.005 mg/L	None	0.005 mg/L	0.01 mg/kg	
	trans-1,2-dichloroethene	Tolune	<u>X</u>	Naphthalene - 7ft	0.1 mg/L	None	0.001 mg/L	0.01 mg/kg	
	1,1-dichloroethane	Ethylbenzene	X	Naphthalene - 10ft	0.05 mg/L	None	0.001 mg/L	0.01 mg/kg	
	1,2-dichloroethane	m/p-xylene	X	Naphthalene - 13ft	0.001 mg/L	None	0.05 mg/L	0.01 mg/kg	
	1,1,1-trichloroethane		^	Napitulaiene - 13tt	None	None	None	None	
Chemicals of		o-xylene							
Concern	1,1,2-trichloroethane		-		None	None	None	None	
	1,1,2,2-tetrachloroethane		-		None	None	None	None	
	Vinyl Chloride		-	_	None	None	None	None	
					None	None	None	None	
					None	None	None	None	
				_	None	None	None	None	
			<u> </u>		None	None	None	None	
			<u> </u>		None	None	None	None	
					None	None	None	None	
Comme	nts:								
Chemicals of interest: Trichloroethene (TCE), Tetrachloroethene (PCE), 1,1,-Trichloroethane (1,1 TCA), 1,1-Dichloroethane (1,1 DCA), cis 1,2-Dichloroethane (cis 1,2 DCA), Trimethylbenzene (TMB), and Naphthalene (Naph). All average post treatment soils concentrations were 0.005 mg/Kg but were listed as 0.01									
m/Kg due spreadsheet constraints.									
Attachmer	nts:								

Comments:

Attachments:

Ther	mal Treatment - Design								Facility ID#:	0180
<u>x</u>	Thermal treatment:		Condu	ctive						
			Electri	cal Resistance						
			-	3 phase	_	6 phase		_ AC power	DC	power
		<u>X</u>	Steam							
			-	Steam	_	Steam + ai	r	Steam + O2		
			Other ((describe)						
<u>X</u>	Type of Test: X	Pilot	test	Full	-					
<u>X</u>	Geology of Treatment Zone) :	-					nconsolidated		
			-	•	_			unconsolidate		
			-	_					·	ability material
			-		-			-	of higher pern	neability material
			-			ctured bedroc		talline rock)		
.,						k, limestone, s				
<u>X</u>	Treatment Targe Zone:			ated only	v	adose only	<u>X</u>		ted and Vadose	zones)
<u>X</u>	Start of Thermal Test:		1999			Dura	ation: <u>70 c</u>	<u>i</u>		
<u>X</u>	Hydraulic Control	<u>X</u>	Yes	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				2500			Unkno	wn (x ft)
	Thickness of target zone (ft):			<u>19</u>			Unkno	wn	
	Depth to top of target zone	(ft bg	s):		<u>0</u>			Unkno	wn	
	Thickness of target zone be	elow v	vater ta	ble (ft):	<u>12</u>			Unkno	wn	
	Number of energy delivery	points	s:		<u>12</u>			Unkno	wn	
	Number of extraction points	3:			<u>3</u>			Unkno	wn	
V	Tanana antona Barfila									
X	Temperature Profile:	o (do	~ C\.			20			I Indonesia	
	Initial formation temperature			oratura (dog C	·).	<u>20</u>		•	Unknown Unknown	
	Maximum representative fo		-			<u>90</u>		•		
	Time to reach maximum rep					<u>25</u>		•	Unknown Unknown	
	Duration of treatment at rep	nesei	itative t	emperature (u	ays).	<u>35</u>		•	Unknown	
							<u>Date</u>		Temperatu	re (deg C)
	Formation temperature imm	nediat	ely pos	t-treatment:						
	Formation temperature pos	t-trea	tment m	nonitoring ever	nt 1:					
	Duration of post-treatment	monit	oring (d	ays):						
V	Mana of contaminant varia	. ما،								
<u>X</u>	Mass of contaminant remov		numnin	~.				114	lua.	I Indonesia
			pumpin	y				_ lb .	kg	Unknown
			tream:	_	1	042		_ lb	kg	Unknown
	Tota	١.			1	<u>943</u>		_ lb	<u>X</u> kg	Unknown
	Comments:									
	Attachments:									

Cos	st and Performance					Facility ID#:	<u>0180</u>
	_ Performance						
	Remediation Goal:						
		 In Groundwater: —					
		0.00					
		 In Soil:					
	Was the Remediation	on Goal Achieved:					
		_ In Groundwater _					
		Comment: -					
		_ In Soil					
		Comment: -					
	Conoral comments	on the thermal applica	ation:				
	General comments	оп те тетпагарриса	auon.				
	Objective: De	termine if steam is a c	cost effective in-situ re	emedial technology	to remove chlorina	ated hydrocarbo	n in the identified
	NAPL zone.						
	Lessons Learned						
							
							
X	Energy						
_	Total Energy Used:			kWhr	kWhr/m ³	kW	/hr/yd ³
		al energy applied to t	reatment zone:	820,000 kw-hr			kWhr/yd ³
		ner energy:		<u>020,000 KW III</u>		_ kWhr/m ³	kWhr/yd ³
		37	note other energy:				kvviii/yd
		Flease	note other energy.				
	_ Cost						
	Total Project Cost:						
	Co	nsultant Cost:					
	The	ermal Vendor Cost:					
	En	ergy Cost:			m³	_ yd ³	
		ner Cost 1:					
		ner Cost 2:					
		ner Cost 3:					
	Please note ot		Other Cost 1:				
	F ICASE HOLE OF						
		_	Other Cost 2:				
			Other Cost 3:				

File Analyzed By: <u>x</u> PD ____ Date: 11/3/2006 ____Other: Type of treatment: ___ Conductive Steam ERH ____ Pesticides Type of Contaminant: _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ___ Active Post Type of Test: Pilot Test Full Scale System End of Test: <u>9/23/1994</u> Start of Test: 7/5/1994 Duration: 80 days Type of Site: ____Non-DOD DoD <u>X</u> Facility Name: NAS Lemoore Address: City, State, Zip Code: Lemoore, CA OU# or Site #: Site 17 Primary point of contact: Kent Udell Organization: University of Utah Address: 50 S Central Campus Dr. RM 2110 MEB City, State, Zip Code: Salt Lake City, UT 84112 Phone #: 801-581-7934 email: udell@eng.utah.edu Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: Vendor, Consultant ____ Other Organization: Address: City, State, Zip Code: Phone #: email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0190

General Site Information

___ Hydraulic Conductivity information

x Impacted	- "		Width (ft):	366 Thick	ness (ft): <u>20</u>		Unknown
		as defined by documentation					
	-	nod for determining size of im	pacted zone (See source zo	one definition attachmer	nts)		
	Map attachment	t					
<u>x</u> Monitor \	Wells: Number of relevant n	nonitoring wells with ground					None
			Pre-treatment:	8	Post-treatment:	<u>8</u>	
	Number of wells relat	tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ossgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	ossgradient:	
x Soil Borin	gs: Number of relevant so	oil borings with pre-treatment	data: <u>4</u>				
	Number of relevant so	oil borings with post-treatmer	nt data: 4				
	Number inside treatme	ent zone:	_ Number outside	e treatment zone:			
x Types of	Contaminants						
					ent Concentration per nical:		ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane	x JP-5		None	None	None	None
Concern	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
	- vinyi cinoride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
							•
				None	None	None	None
Comme	ents:						
							
Attachme	nts:						
	-			<u> </u>			

0190

General Site Assessment Data

Hydrogeologic Conceptual Model Facility ID#: 0190 Geology: **Unconsolidated Sediments** Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: _ Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) _ Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _____ft amsl _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): <u>16</u> high value (ft bgs): Unknown:

Flow direction				
Horizontal hydraulic gradient Vertical hydraulic gradient (fe				Unknowr
K range (ft/day)		Slug Test	Laboratory	Field data
Transmissivity (ft2/day):	high Measured using: low	Slug Test	Laboratory	Field dataUnknown
	high			

Shallow sandy silt permeability - 4e-12 m2 deeper sandy silt permeability - 14e-12 m2

Attachments:

Comments:

The	rmal Treatment - Design								Facility ID#:	<u>0190</u>	
<u>x</u>	Thermal treatment:		_ Conductiv	e							
			_ Electrical	Resistance							
		<u>x</u>	Steam	_ 3 phase		6 phase		_AC pow	er D	C power	
		~		_ Steam		Steam + air		_ Steam +	O2		_
.,	Time of Teets	D:1.4	Other (des		1. 6						_
X	Type of Test: <u>x</u> Geology of Treatment Zone	Pilot		Full-			ooblo un	concolida	tod codiments		
<u>x</u>	Geology of Treatment Zone	.		_		geneous and permogeneous and imper					
			<u>x</u>	-		ole sediments with					ial
			~			able sediments with			-	-	
						ractured bedrock (ouby ma	
						ock, limestone, sar			7		
<u>x</u>	Treatment Targe Zone:		Saturated	 '		Vadose only	<u>x</u>	Both (Sa	turated and Vados	e zones)	
<u>x</u>	Start of Thermal Test:	7/5/1		·		•	on: <u>80 d</u>				
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No							
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):				48125	<u>i</u>		Ur	nknown (<u>275</u> x <u>17</u>	<u>(5</u> ft)
	Thickness of target zone (fi	t):			<u>20</u>			Ur	nknown		
	Depth to top of target zone	(ft bg	ıs):		<u>5</u>			Ur	nknown		
	Thickness of target zone be	elow v	water table	(ft):	9			Ur	nknown		
	Number of energy delivery	-	s:		2			Ur	nknown		
	Number of extraction points	S:			<u>8</u>			Ur	nknown		
<u>x</u>	Temperature Profile:										
	Initial formation temperatur	e (de	g C):			<u>25</u>			Unknow	/n	
	Maximum representative for	rmati	on tempera	ature (deg C):	<u>100</u>			Unknow	/n	
	Time to reach maximum re	prese	ntative tem	perature (da	ays):	<u>10</u>			Unknow	/n	
	Duration of treatment at rep	oreser	ntative tem	perature (da	ays):	<u>70</u>			Unknow	/n	
						<u></u>	<u>Date</u>		<u>Temperat</u>	ure (deg C)	
	Formation temperature imm	nediat	tely post-tre	eatment:		9/23/1994			<u>98</u>		
	Formation temperature pos	t-trea	tment mon	itoring event	t 1:	10/3/1994			<u>74</u>		
	Duration of post-treatment	monit	oring (days	s):							
<u>x</u>	Mass of contaminant remove	ved:									
	Via I	iquid	pumping:		7.	5300 gal		_ lb	kg	Un	know
	In va	apor s	tream:		<u>3</u>	179 gal		_lb	kg	Un	know
	Tota	l:			78	3479 <u>gal</u>		_ lb	kg	Un	know
	Comments:										
	Attachments:										

st and Performance					Facility ID#:	<u>0190</u>
_ Performance						
Remediation Goal:	_					
	_ In Groundwater: -					
_	In Soil:					
Was the Remediation	on Cool Ashiovade					
	In Groundwater Comment: _					
	Comment: —					
	 In Soil					
	Comment:					
	Comment.					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
_ Energy						
Total Energy Used:			kWhr			
To	tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd
Oth	ner energy:	_		. <u>-</u>	_ kWhr/m ³	kWhr/yd
	Please	note other energy:				
_						
_ Cost						
Total Project Cost:						
	nsultant Cost:					
	ermal Vendor Cost:					
En	ergy Cost:			m ³	_ yd³	
Oth	ner Cost 1:					
Oth	ner Cost 2:					
Oth	ner Cost 3:					
Please note of	ther cost:	Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD	a .	V 50V		Date:	11/8/2006
	Type of treatment:	Conductive	Steam	_	Other:		
	Type of Contaminant:	X Chlorinated Sol	vents	Petroleum Hydro	carbons	Pesticides	
	Treatment Status:	Wood Treating Active	X Post	Other:			
	Type of Test:	X Pilot Test		Scale System			
	Start of Test:	6/21/2002		End of Test: <u>1/3/2003</u>		Duration: 197 d	
	Type of Site:	Non-DOD	<u>X</u> DoD				
<u>X</u>	Facility Name: <u>NAS Alan</u>	meda Point Site 5 ERH P	<u>Pilot</u>				
	Address:						-
	City, State, Zip Code:	Alameda, CA					
	OU# or Site #: Site 5, Plu	me 5-1					
<u>X</u>	Primary point of contact:	Steven Peck					
	Organization: <u>Navy</u>						
	Address: 1455 Frazee Rd.	, Ste. 900					
	City, State, Zip Code:	San Diego, CA 92108	<u>8</u>				
	Phone #: <u>619-532-0786</u>		email	steven.peck@navy.mil			
<u>X</u>	Other contacts or vendors when	ho worked on site		None			
	Point of contact: <u>John</u>	n McGuire					
	Type: <u>X</u> Vendor, C	Consultant	Vendor, Te	chnical Applications	Oth	ner	
	Organization: Shaw						
	Address:						<u> </u>
	City, State, Zip Code:						
	Phone #: 925-288-2220		email	john.mcguire@shawgrp	o.com		
Q	A/QC						
	Observatoristics of laterace						
_	_		to.	C1-	and nost toto-	nt coil date	
					•	ni son data	
							
				Geologic ci	OSS-SECTION		
		eatment groundwater dat file vs. time information		Good pre- a Flux assess Geologic cr		nt soil data	

0200

General Site Information

X Impacted Zone:		Zone:	Length (parallel to flow	direction)(ft.): 230 s defined by documentation	Wid	th (ft):	<u>130</u> Thick	ness (ft): <u>20</u>		Unknown			
			· 	od for determining size of im	pacted zone	(See source	zone definition attachmer	nts)					
			Map attachment										
X Mo	nitor W	/ells:	Number of relevant m	onitoring wells with groundy	vater data:					None			
						Pre-treatmen	t: <u>15</u>	Post-treatment:	<u>15</u>				
			Number of wells relati	ve to treatment zone:									
			Pre-treatment	In: <u>6</u>	Upgradien	t: <u>3</u>	Downgradient:	<u>6</u> Cro	ssgradient:				
			Post-treatment	In: <u>6</u>	Upgradien	t: <u>3</u>	Downgradient:	<u>6</u> Cro	ssgradient:				
0-11	D. de		North an of a layers and	the single conditions to the standard of	data								
5011	Boring	IS:		Il borings with pre-treatment									
			Number of relevant sor	Il borings with post-treatmen		lumbor outoi	de treatment zone:						
			Number inside treatme	ent zone.	_ ''	Number outsi	de treatment zone.						
<u>х</u> Туре	Types of Contaminants												
	Average Pre-treatment Concentration per Chemical: Average Post-treatment Concentration per Chemical: Chemical:												
			Chlorinated Solvents	Petroleum Hydrocarbons	О	ther	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
		<u>х</u> т	richloroethene	Hexane	Creosot	<u>e</u>	1 mg/L	None	1 mg/L	None			
		<u>х</u> т	etrachloroethene	Jet Fuel			0.05 mg/L	None	1 mg/L	None			
		<u>X</u> 1	,1-dichloroethene	Napthalene			1 mg/L	None	5 mg/L	None			
		<u>X</u> c	is-1,2-dichloroethene	Benzene			0.5 mg/L	None	10 mg/L	None			
		X tr	ans-1,2-dichloroethene	Tolune			0.05 mg/L	None	1 mg/L	None			
		<u>X</u> 1	,1-dichloroethane	Ethylbenzene			5 mg/L	None	5 mg/L	None			
		<u>X</u> 1	,2-dichloroethane	m/p-xylene			0.05 mg/L	None	1 mg/L	None			
Chemica	als of	<u>X</u> 1	,1,1-trichloroethane	o-xylene			10 mg/L	None	50 mg/L	None			
Conce		<u>X</u> 1	,1,2-trichloroethane				0.05 mg/L	None	10 mg/L	None			
		1	,1,2,2-tetrachloroethane				None	None	None	None			
		<u>x</u> v	inyl Chloride				0.1 mg/L	None	1 mg/L	None			
				<u> </u>			None	None	None	None			
							None	None	None	None			
							None	None	None	None			
							None	None	None	None			
							None	None	None	None			
							None	None	None	None			
C	ommer	oto:											
C	omme	its.											
		4	Attached sheet in file sho	ws average concentration in			tment at shallow, interme. Pilot was within the		ervals. Only concent	rations from shallow			
Atta	chmen	ts: -											
		-											
		-											

0200

General Site Assessment Data

Hyd	rogeologic Conceptual	Model		Facility ID#:	0200
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material higher permeability material diments sediments wer permeability material	
<u>X</u>	Ground surface eleva	ation based on wells in o	or adjacent to treatment zone: 10 ft amsl	Unknown	
X	Aquifer Characteristic Is more than 1 aquife Depth to water:			aknown (assume single aquife	er)
<u>X</u>	Flow direction		North to northeast		
X	Horizontal hydraulic ç Vertical hydraulic gra		0.004 to 0.006	Unknown	
X	K range (ft/day) Transmissivity (ft2/day)	Measured low high ay): Measured low high	<u>0.737</u> 4.819	Field data Unknown Field data Unknown	

Comments:

Attachments:

S=0.007

The	mal Treatment - Design									Facility II	D#:	0200	
<u>X</u>	Thermal treatment:		_ Conductive	·									
		<u>X</u>	Electrical I	Resistance									
				_ 3 phase	<u>X</u>	6 phase			AC powe	r	DC pc	ower	
			_ Steam				-						
				_ Steam	_	Steam +	air		Steam + 0	02			
			Other (desc	cribe)									
<u>X</u>	Type of Test: \underline{X}	Pilot	test	Full-	-scale Syst	em							
<u>X</u>	Geology of Treatment Zone	e:		_ Relatively	homoger	neous and p	permeat	ole und	onsolidat	ed sedimen	its		
				_ Relatively	homoger	neous and i	mperme	eable u	nconsolio	lated sedim	ents		
			X	Largely pe	ermeable	sediments	with inte	er-bedo	ded lense	s of lower p	ermeab	ility mat	terial
				_ Largely in	npermeab	le sedimen	ts with i	nter-be	edded lay	ers of highe	r perme	ability r	naterial
				_ Competer	nt, but fra	ctured bedr	ock (i.e.	crysta	lline rock)			
				_ Weathere	d bedrock	k, limestone	, sands	tone					
<u>X</u>	Treatment Targe Zone:	_	_ Saturated	only	Va	adose only		<u>X</u>	Both (Sat	urated and V	adose zo	ones)	
<u>X</u>	Start of Thermal Test:	6/21	/2002			Du	uration:	<u>197 d</u>	:				
<u>X</u>	Hydraulic Control	<u>X</u>	Yes	No									
<u>x</u>	Treatment Cell Design:												
_	Size of target zone (ft2):				1250				Un	known	(40	x	40 ft)
	Thickness of target zone (ft	t):			30				Uni		` _		_ ′
	Depth to top of target zone		ıs):		0				Uni				
	Thickness of target zone be			(ft):	23					known			
	Number of energy delivery			()	12					known			
	Number of extraction points				<u>16</u>					known			
<u>X</u>	Temperature Profile:												
	Initial formation temperature	e (de	g C):			<u>25</u>				Un	known		
	Maximum representative for	rmati	on tempera	ture (deg C	:):	<u>100</u>				Un	known		
	Time to reach maximum re	prese	ntative tem	perature (da	ays):	<u>169</u>				Un	known		
	Duration of treatment at rep	oresei	ntative temp	erature (da	ays):	<u>28</u>				Un	known		
							Date	<u>e</u>		<u>Temp</u>	erature	(deg C	<u>)</u>
	Formation temperature imn	nedia	tely post-tre	atment:									_
	Formation temperature pos	t-trea	tment moni	toring even	t 1:								_
	Duration of post-treatment	monit	oring (days):									_
<u>X</u>	Mass of contaminant remov	ved:											
_			pumping:						lb	kg		1	Unknowi
		-	tream:							kg			Unknowi
	Tota				8	81		X	lb	kg			Unknowi
	. 5	•••			_	· <u>·</u>							C 1111110 W
	Comments:												
				.,				- •					
		spa	cing - 20 ft	. Vapor e	extraction	n well spac	ing - 15	ott.					
	Attachments:												

Cos	t and Performance					Facility ID#:	0200
X	Performance						
_	Remediation Goal:						
	X	In Groundwater:					
	=			10 000 ug/L	for contaminan	t	
		In Soil:		10,000 ug/E	ior comaminari	<u></u>	
	Was the Remediation	n Goal Achieved:					
		_ In Groundwater					
		Comment: -					
		-					
		_ In Soil					
		Comment: -					
		_					
		_					
	General comments of	on the thermal applica	ation:				
	Determine vari	ability of SPH at site	5 and generate desig	n parameters for full-sc	ale treatment	On July 25	2002 double-wve
	3-phase power	configuration was re	wired to a true 6-pha	se configuration.	alo troduniona	011 041,7 20	1 2002; 4042.0 11;0
	Lessons Learned						
	Double-wye 3-	ohase configuration of	on electrodes cause p	ower application to go	awry.		
V	F						
<u>X</u>	Energy				/ 3		, ,3
	Total Energy Used:	<u></u>		kWhr			
			reatment zone:	428874 kw hour			kWhr/yd ³
	Oth	er energy:				kWhr/m ³	kWhr/yd ³
		Please	note other energy:	-			
	_ Cost						
	_ Cost Total Project Cost:						
	•						
	' <u></u> '	nsultant Cost:					
	· 	rmal Vendor Cost:			3	.3	
		ergy Cost:		n	n ³	_yd³	
		er Cost 1:	-				
	Oth	er Cost 2:					
	Oth	er Cost 3:	_				
	Please note oth	ner cost:	Other Cost 1:				
			Other Cost 2:				

____ Other Cost 3:

<u>X</u> PD ____ File Analyzed By: Date: 11/6/2006 Type of treatment: Conductive __ Steam X ERH ____ Pesticides Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: ___ Pilot Test X Full Scale System Start of Test: 7/8/2004 End of Test: 11/5/2004 Duration: 120 d Type of Site: ___Non-DOD DoD <u>X</u> Facility Name: NAS Alameda Point Full Scale Address: City, State, Zip Code: Alameda, CA OU# or Site #: Site 5, Plume 5-1 Primary point of contact: Steven Peck Organization: Address: 1455 Frazee Rd., Ste. 900 City, State, Zip Code: San Diego, CA 92108 Phone #: 619-532-0786 email: steven.peck@mavy.mil Other contacts or vendors who worked on site _None Point of contact: John McGuire Type: <u>X</u> Vendor, Consultant ___ Vendor, Technical Applications __Other Organization: Shaw Address: City, State, Zip Code: Phone #: 925-288-2220 email: john.mcguire@shawgrp.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data __ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _Geologic cross-section

Facility ID#:

0215

General Site Information

___ Hydraulic Conductivity information

Impacted zone		Impacted zone a	as defined by documentation od for determining size of im		Width (ft): ted zone (See source zo		ckness (ft): 20		Unknown		
<u>X</u>	Monitor V		nonitoring wells with ground	vate	r data: Pre-treatment:	<u>17</u> Post-treatment: <u>17</u>			None		
			ive to treatment zone:								
		Pre-treatment	In: <u>17</u>	ι	Jpgradient:	Downgradient:		ssgradient:			
		Post-treatment	In: <u>17</u>	ι	Jpgradient:	Downgradient	: Cro	ssgradient:			
<u>x</u>	Soil Borings: Number of relevant soil borings with pre-treatment data: Number of relevant soil borings with post-treatment data: Number inside treatment zone: Number outside treatment zone: Types of Contaminants										
Δ	1 ypc3 01 C	ontaminants								_	
							ment Concentration per	Average Post-treatm		er	
		C11 : 10.1	B. 1 W. 1		0.1		emical:		nical:	_	
		Chlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)		Groundwater (mg/L)	Soil (mg/kg)		
		Trichloroethene	Hexane	_	Creosote	None	None	None	None	_	
		Tetrachloroethene	Jet Fuel	X	111 TCA - Shallow	10 mg/L	None	0.001 mg/L	None		
		1,1-dichloroethene	Napthalene	<u>X</u>	112 TCA - Shallow	0.05 mg/L	None	0.001 mg/L	None		
		cis-1,2-dichloroethene	Benzene	<u>X</u>	11 DCA - Shallow	10 mg/L	None	0.001 mg/L	None		
		trans-1,2-dichloroethene	Tolune	<u>X</u>	11 DCE - Shallow	5 mg/L	None	0.005 mg/L	None		
		1,1-dichloroethane	Ethylbenzene	<u>X</u>	12 DCA - Shallow	0.05 mg/L	None	0.001 mg/L	None		
		1,2-dichloroethane	m/p-xylene	<u>X</u>	cis-12 DCE - Shallow	1 mg/L	None	0.01 mg/L	None		
C 1	nemicals of	1,1,1-trichloroethane	o-xylene	<u>X</u>	PCE - Shallow	0.05 mg/L	None	0.01 mg/L	None		
	Concern	1,1,2-trichloroethane		<u>X</u>	trans-12 DCE - Shallow	0.1 mg/L	None	0.005 mg/L	None		
		1,1,2,2-tetrachloroethane		<u>X</u>	TCE - Shallow	1 mg/L	None	0.1 mg/L	None		
		Vinyl Chloride		<u>X</u>	VC - Shallow	1 mg/L	None	0.001 mg/L	None		
						None	None	None	None		
					<u></u>	None	None	None	None		
					•	None	None	None	None		
						None	None	None	None		
						None	None	None	None		
						None	None	None	None		
				I—		None	None	None	TVOIC	_	
	Comme	nts:									
										_	
										_	
							 _				
	Attachmen	ts:								_	
		· ·								_	
										_	

0215

General Site Assessment Data - Page 1

<u>X</u>	Impacted 2	0 "			Width (ft):	<u>130</u> Th	ickness (ft):	<u>20</u>	_	Unknown
			as defined by documentation							
		Alternative meth	nod for determining size of in	npac	ted zone (See source zo	ne definition attachm	nents)			
		Map attachment								
<u>X</u>	Monitor W	/ells: Number of relevant n	monitoring wells with groundwater data:						_	None
					Pre-treatment:	<u>17</u>	Post-treatment:	<u>17</u>		
		Number of wells relat	tive to treatment zone:							
		Pre-treatment	ln: 17	ι	Jpgradient:	Downgradien	t:	Crossgradient:	_	
		Post-treatment	In: <u>17</u>	ι	Jpgradient:	Downgradien	t: (Crossgradient:		
			_			_			_	
	Soil Boring	is: Number of relevant so	oil borings with pre-treatmen	t dat	a·					
			oil borings with post-treatmen							
		Number inside treatme		it do		treatment zone:				
		Number made treatm	ent zone.	_	Number outside	treatment zone.				
~	Types of C	contaminants								
<u>X</u>	Types of C	ontaminants		Τ						
							ment Concentration per			Concentration per
							nemical:		hemica	
		Chlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L		Groundwater (mg/I	.)	Soil (mg/kg)
		Trichloroethene	Hexane	-	Creosote	None	None	None	-	None
		Tetrachloroethene	Jet Fuel	X	111 TCA - Intermed.	0.001 mg/L	None	0.001 mg/L	_	None
		1,1-dichloroethene	Napthalene	<u>X</u>	112 TCA - Intermed.	0.001 mg/L	None	0.001 mg/L	_	None
		cis-1,2-dichloroethene	Benzene	<u>X</u>	11 DCA - Intermediate	0.05 mg/L	None	0.001 mg/L	_	None
		trans-1,2-dichloroethene	Tolune	X	11 DCE - Intermediate	0.001 mg/L	None	0.001 mg/L		None
		1,1-dichloroethane	Ethylbenzene	<u>X</u>	12 DCA - Intermediate	0.001 mg/L	None	0.001 mg/L		None
		1,2-dichloroethane	m/p-xylene	<u>X</u>	cis-12 DCE - Intermed.	0.001 mg/L	None	0.01 mg/L		None
Cha	uminala af	1,1,1-trichloroethane	o-xylene	<u>x</u>	PCE - Intermediate	0.001 mg/L	None	0.001 mg/L		None
	emicals of concern	1,1,2-trichloroethane		X	trans-12 DCE - Inter.	0.001 mg/L	None	0.001 mg/L		None
		1,1,2,2-tetrachloroethane		<u>x</u>	TCE - Inermediate	0.001 mg/L	None	0.001 mg/L		None
		Vinyl Chloride		X	VC - Intermediate	0.005 mg/L	None	0.001 mg/L		None
						None	None	None		None
						None	None	None		None
						None	None	None		None
						None	None	None		None
						None	None	None		None
						None	None	None	\top	None
		<u> </u>		-		Hone	None	None		TYONG
	Comme	nts:								
		-								
					-					
	Attachmen	ts:								

0215

General Site Assessment Data - Page 2

0215

<u>X</u>	Geology:	Zone	Unconsolidated S	Sediments				
		Vadose Zone:	Relatively h	omogeneous and	d permeable u	nconsolidated sed	diments	
			Relatively h	omogeneous and	d impermeable	unconsolidated s	sediments	
			X Largely perr	neable sediment	ts with inter-be	dded lenses of lo	wer permeability materi	ial
			Largely imp	ermeable sedime	ents with inter-	bedded layers of	higher permeability ma	terial
			Competent,	but fractured be	drock (i.e. crys	stalline rock)		
			Weathered	bedrock, limesto	ne, sandstone			
		Saturated Zone:	Relatively h	omogeneous and	d permeable u	nconsolidated sed	diments	
			Relatively h	omogeneous and	d impermeable	unconsolidated s	sediments	
			X Largely perr	neable sediment	ts with inter-be	dded lenses of lo	wer permeability materi	ial
			Largely imp	ermeable sedime	ents with inter-	bedded layers of	higher permeability ma	terial
			Competent,	but fractured be	drock (i.e. crys	stalline rock)		
			Weathered	bedrock, limesto	ne, sandstone			
<u>X</u>	Ground surface ele	evation based on wells in	n or adjacent to treatn	nent zone:	<u>10</u>	ft amsl	Unknown	n
<u>X</u>	Aquifer Characteri							
	Is more than 1 aqu	uifer present?	No	Yes (number):		_	nknown (assume single aq	juifer)
			Aquifer 1	Aqui	ifer 2	Aquifer 3		
	Depth to water:	low value (ft bgs):	<u>507</u>		 _			
		high value (ft bgs):						
		Unknown:					:	
v	Flow direction		N. C. NE					
<u>X</u>	Flow direction		N to NE	-				
<u>X</u>	Horizontal hydraul	ic gradient (feet/foot):	0.004 to 0.006				Unknow	n
Δ	•	gradient (feet/foot):	0.004 to 0.000				Unknow	
	vortical riyaradilo (gradioni (1000/1001).						
<u>X</u>	K range (ft/day)	Measure	ed using:	Slug Test	Laborato	īV	Field data	
_	3. (3.1.),	low	0.737			_	Unknow	n
		high	4.819	·				
	Transmissivity (ft2	· ·		Slug Test	Laborato	ry	Field data	
		low	158.4				Unknow	n
		high						
		, and the second						
	Comments:							
	<u>S</u>	S=0.007						
	Attachments: _							
	-							
	-							

The	rmal Treatment - Design										Faci	lity ID#:	<u>0215</u>	
<u>X</u>	Thermal treatment:		Cond	uctive										
		<u>X</u>	Electi	rical Resistar	nce _									
			Steam	3 pha	se	<u>X</u>	6 phase			_AC pov	ver	DC	power	
			-	Steam	ı		_ Steam + a	air		_ Steam -	- O2			
V	Torre of Tort	D.1.		(describe)	-	1 6 .								
<u>X</u>	Type of Test:	_ Pilot	test	X Delet	Full-scal	•			من ما					
X	Geology of Treatment Zon	e:		Relat X Large Large Com	tively horely permely imper ely imperpetent, b	mogene eable s rmeable out fract	eous and p eous and in ediments v e sediments ured bedro limestone,	nperme vith inte s with in ock (i.e.	able er-bed nter-b cryst	unconso ded lens edded la	lidated session of low	ediments ver perme	-	
<u>X</u>	Treatment Targe Zone:		Satu	rated only		Vac	lose only		<u>X</u>	Both (S	aturated a	nd Vadose	zones)	
<u>X</u>	Start of Thermal Test:	7/8/2	2004				Du	ration:	120	<u>d</u>				
<u>X</u>	Hydraulic Control	<u>X</u>	Yes		No									
<u>X</u>	Treatment Cell Design:													
	Size of target zone (ft2):				<u>14</u>	1520				U	nknown	(_ x _	ft)
	Thickness of target zone (ft):			20	<u>)</u>				t	nknown			
	Depth to top of target zone	e (ft bg	s):		<u>0</u>					t	nknown			
	Thickness of target zone b	elow v	vater ta	able (ft):	13	3				t	nknown			
	Number of energy delivery	points	s:		<u>30</u>) electro	des *			t	nknown			
	Number of extraction point	ts:			_					t	nknown			
<u>X</u>	Temperature Profile:													
	Initial formation temperatu	re (de	g C):				<u>220</u>					Unknow	1	
	Maximum representative for	ormati	on tem	perature (d	eg C):		<u>92</u>					Unknowi	1	
	Time to reach maximum re	eprese	ntative	temperatu	re (days)):	<u>90</u>					Unknowi	1	
	Duration of treatment at re	preser	ntative	temperatur	e (days)	:	<u>30</u>					_ Unknowi	ı	
								Date	<u>e</u>		<u>I</u>	emperatu	re (deg C)	
	Formation temperature imi													_
	Formation temperature po-			_	event 1:									_
<u>x</u>	Mass of contaminant remo	wed:												
^			pumpii	aa.		0.1	0		v	lh		leσ	ī	Jnknown
		-		_		0.1			<u>X</u>	lb "	_		·	
			tream:			3011			<u>X</u>	lb 			<u> </u>	Jnknown
	Tota	al:				3011	<u>.46</u>		<u>X</u>	lb		_ kg	(Jnknown
	Comments:													
	* 30 elec	trode	s each	with 4 she	eet piles	<u>S.</u>								

Cos	t and Performance				Facility ID#:	<u>0215</u>
<u>X</u>	Performance					
_	Remediation Goa	:				
)	(In Groundwater:				
	_	-	٦	Total concentrations of the	e COCs below 10,000 ppb.	
	_	In Soil:				
	_					
	Was the Remedia	tion Goal Achieved:				
	2	In Groundwater				
		Comment:				
			<u>ves</u>			
	-	In Soil				
		Comment:				
	General comment	s on the thermal app	lication:			
		o on ano anormal app				
	Target temp	of 92 dea C				
	rargot tomp	<u>01 02 dog 0</u>				
	Lessons Learned					
<u>X</u>	Energy					2
	Total Energy Use					Whr/yd ³
		otal energy applied t	o treatment zone:	1455923 kw-hr	kWhr/m ³	kWhr/yd ³
		Other energy:			kWhr/m ³	kWhr/yd ³
		Pleas	se note other energy:			
	_ Cost					
	Total Project Cost					
	-	Consultant Cost:				
	·	Thermal Vendor Cost:				
				m	³ yd ³	
		Energy Cost:		m	yu	
		Other Cost 1:				
	·	Other Cost 2:				
	·	Other Cost 3:				
	Please note	other cost:	Other Cost 1:			
			Other Cost 2:			

Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	10/26/2006
	Type of treatment:	Conductive	Steam	n <u>x</u>	ERH	Other:		
	Type of Contaminant:	Chlorinated Solven	ts	Petr	roleum Hydroca	arbons	Pesticides	
		Wood Treating		Oth	er:			
	Treatment Status:	x Active	Post					
	Type of Test:	Pilot Test x	Full	Scale Syste	em			
	Start of Test:			End of Tes	st:		_ Duration:	
	Type of Site:	Non-DOD	DoD					
<u>x</u>	Facility Name: NAS Alam	<u>neda</u>						
	Address:							
	City, State, Zip Code:	Alameda, CA						
	OU# or Site #: Site 5-3							
<u>X</u>	Primary point of contact:	John McGuire						
	Organization: Shaw							
	Address:							
	City, State, Zip Code:							
	Phone #: 925-288-2220		email	john.mcgu	ire@shawgrp.co	<u>m</u>		
<u>x</u>	Other contacts or vendors wh	no worked on site			None			
	Point of contact: <u>Stev</u>	en Peck						
	Type:Vendor, C	onsultant\	/endor, Te	echnical Ap	plications	<u>x</u> Oth	ier	
	Organization: <u>Navy</u>							
	Address: 1455 Frazee Roa	nd, Suite 900						
	City, State, Zip Code:	San Diego, CA 92108						
	Phone #: <u>619-532-0786</u>		email	: steven.pec	ck@navy.mil			
Q.	A/QC							
	_ Characteristics of Interest							
	Good pre- and post-tre	atment groundwater data			_ Good pre- an	d post-treatme	nt soil data	
	Good temperature prof	file vs. time information		_	Flux assessm	ient		
	Groundwater elevation	ns		_	Geologic cro	ss-section		
	Hydraulic Conductivity	y information						

0213

General Site Information

General Site A	ssessment Data					Facility II	D#: <u>0213</u>
Impacted	d Zone: Length (parallel to flow	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
	 -	as defined by documentation					
	·	=	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment	t					
Monitor	Wells: Number of relevant n	nonitoring wells with ground					None
			Pre-treatment:		Post-treatment:		
	Number of wells related Pre-treatment	tive to treatment zone:	He are disease	D	0		
		In:	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
Soil Borir	ngs: Number of relevant so	oil borings with pre-treatment	data:				
0011 D0111		oil borings with post-treatmen					
	Number inside treatme			treatment zone:			
	ramber mode deading		_ rumber outside				
Types of	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
_	<u> </u>						
Comm	ents:						
							
Attachme	ents:				-		

Hydrogeologic Conceptual Model Facility ID#: 0213

<u>x</u>	Geology:	Zone	<u>Unconsolidated Sediments</u>	
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments	
			Relatively homogeneous and impermeable unconsolidated sedimer	nts
			<u>x</u> Largely permeable sediments with inter-bedded lenses of lower per	meability material
			Largely impermeable sediments with inter-bedded layers of higher p	permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments	
			Relatively homogeneous and impermeable unconsolidated sedimer	
			x Largely permeable sediments with inter-bedded lenses of lower per	
			Largely impermeable sediments with inter-bedded layers of higher p	•
			Competent, but fractured bedrock (i.e. crystalline rock)	omicability material
			Weathered bedrock, limestone, sandstone	
			vveatricred bedrock, infrestoric, salidatoric	
	_ Ground surface elev	ation based on wells in o	adjacent to treatment zone: ft amsl	Unknown
	_ Aquifer Characteristi	cs:		
	Is more than 1 aquife	er present?	No Yes (number): Unknown ((assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3	
	Depth to water:	low value (ft bgs):		
		high value (ft bgs):		
		Unknown:		
	_ Flow direction			
	_			
	_ Horizontal hydraulic	gradient (feet/foot):		Unknown
	Vertical hydraulic gra	,		Unknown
	g			
	_K range (ft/day)	Measured	using: Slug Test Laboratory Field	l data
	_ re range (reday)	low		Unknown
		high		Challown
	Transmissivity (ft2/da	· ·	using: Slug Test Laboratory Field	l data
	Transmissivity (112/4)	low	Laboratory rote	Unknown
				Unknown
		high		
	Comments:			
	=		-	
	Attachments:			
	_			

The	ermal Treatment - Design						Facility I	D#:	<u>0213</u>
<u>x</u>	Thermal treatment:		Conductive						
		<u>x</u>	Electrical Re	esistance					
				3 phase	6 phase	AC I	oower	DC po	wer
			Steam	g.	G	G.	. 02		
				Steam	Steam + ai	r Stear	m + O2		
v	Type of Test:	Pilot 1	Other (descr		nala Svatam				
<u>x</u>	Type of Test: Geology of Treatment Zor			_	cale System	rmaahla unaansa	lidatad sadimar	ote	
	_ Geology of Treatment Zor	ie.		-	omogeneous and pe				
				-	omogeneous and im meable sediments wi	•			ity material
					ermeable sediments		•		-
					but fractured bedroo			n pennec	ability material
				-	bedrock, limestone,		iock)		
	Treatment Targe Zone:		Saturated of			Both	(Saturated and V	Jadose zo:	nec)
_	_ Start of Thermal Test:		Saturateu C	Jilly .		ation:			
	Hydraulic Control		Yes	No					
			103						
	_ Treatment Cell Design:								
	Size of target zone (ft2):						Unknown	(x ft)
	Thickness of target zone (ft)·		•			Unknown	\ <u> </u>	x n)
	Depth to top of target zone		:).	•			Unknown		
	Thickness of target zone b			t)·			Unknown		
	Number of energy delivery			.,.			Unknown		
	Number of extraction poin			•			Unknown		
	Number of extraction point			=			Clikilowii		
	_ Temperature Profile:								
	Initial formation temperatu	re (dea	C).				Un	known	
	Maximum representative f			ire (dea C).				known	
	Time to reach maximum re		•				Un		
	Duration of treatment at re	•	•				<u></u>	known	
	Duration of treatment at re	presen	tative tempe	erature (uay				KIIOWII	
						Date	Temr	oerature ((dea C)
	Formation temperature im	mediate	alv nost-trea	tment:		Date	<u>1611)</u>	<u>Jerature (</u>	ueg O)
	Formation temperature po				1.				
	Duration of post-treatment			-					
	Duration of post-treatment	· IIIOIIIIC	illig (days).						
	Mass of contaminant remo	wed.							
	 '		oumping:			lb	kg		Unknown
		apor st				lb	kg		Unknown
	Tot	•	cam.			lb	_	•	Unknown
	100	aı.				10	kg	•	CIIKIIOWII
	Comments:								
	Attachments:								
	Audonnients.								

Performance						Facility ID#	#:	<u>0213</u>
Remediation Goal:	_							
	In Groundwater: -							
	In Soil:							
Was the Remediation (
	Comment: -							
	-							
	In Soil _							
	Comment: -							
	-							
General comments on	the thermal applica	ation:						
Lessons Learned								
Energy								
			kWhr	k	Whr/m ³		kWh	r/yd³
Total Energy Used:	energy applied to	treatment zone:	kWhr	k			_ kWh	
Total Energy Used:Total	energy applied to to	treatment zone:	kWhr	k		_kWhr/m³	_ kWh	kWhr/y
Total Energy Used:	energy:	_	kWhr	k			_ kWh	
Total Energy Used:Total	energy:	treatment zone:	kWhr	k		_kWhr/m³	_ kWh	kWhr/y
Total Energy Used:Total	energy:	_	kWhr	k		_kWhr/m³	, kWh	kWhr/y
Total Energy Used: Total Other	energy:	_	kWhr	k		_kWhr/m³	_ kWh	kWhr/y
Total Energy Used: Total Other Cost Total Project Cost:	energy:	_	kWhr	k		_kWhr/m³	, kWh	kWhr/y
Total Energy Used: Total Other Cost Total Project Cost: Const	energy: Please	_	kWhr	k		_kWhr/m³	, kWh	kWhr/y
Total Energy Used: Total Other Cost Total Project Cost: Const Therm	r energy: Please ultant Cost: mal Vendor Cost:	_	kWhr	_		_ kWhr/m ³ _ kWhr/m ³	₋ kWh	kWhr/y
Total Energy Used: Total Other Cost Total Project Cost: Const Therm Energy	energy: Please ultant Cost: nal Vendor Cost: gy Cost:	_	kWhr	k		_kWhr/m³	kWh	kWhr/y
Total Energy Used: Total Other Cost Total Project Cost: Consumption Therm Energy Other	ultant Cost: nal Vendor Cost: gy Cost:	_	kWhr	_		_ kWhr/m ³ _ kWhr/m ³	_ kWh	kWhr/y
Total Energy Used: Total Other Cost Total Project Cost: Consumption Therm Energy Other	r energy: Please ultant Cost: mal Vendor Cost: gy Cost: Cost 1:	_	kWhr	_		_ kWhr/m ³ _ kWhr/m ³	<u>,</u> kWh	kWhr/y
Total Energy Used: Total Other Cost Total Project Cost: Consumption Therm Energy Other	renergy: Please ultant Cost: mal Vendor Cost: gy Cost: Cost 1: Cost 2:	_	kWhr	_		_ kWhr/m ³ _ kWhr/m ³	₋ kWh	kWhr/y

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/26/2006
	Type of treatment:	Conductive		_Steam	<u>x</u>	ERH	Other:		
	Type of Contaminant:	Chlorinated Solv	ents		Petr	oleum Hydrod	carbons	Pesticides	;
		Wood Treating		_	Oth	er:			
	Treatment Status:	<u>x</u> Active	_	Post					
	Type of Test:	Pilot Test	<u>x</u>	Full Scal	e Syste	m			
	Start of Test:			End	of Tes	t:		_ Duration:	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: NAS Alam	neda							
	Address:								
	City, State, Zip Code:	Alameda, CA							
	OU# or Site #: Site 4-2								
<u>x</u>	Primary point of contact:	John McGuire							
	Organization: Shaw								
	Address:								
	City, State, Zip Code:								
	Phone #: 925-288-2220			email: joh	n.mcgui	ire@shawgrp.c	<u>om</u>		
<u>x</u>	Other contacts or vendors wh	no worked on site				_ None			
	Point of contact: <u>Stev</u>	en Peck							
	Type:Vendor, C	onsultant	_Ven	dor, Techn	ical Ap	plications	<u>x</u> Oth	ner	
	Organization: <u>Navy</u>								
	Address: 1455 Frazee Roa	d, Suite 900							
	City, State, Zip Code:	San Diego, CA 92108							
	Phone #: <u>619-532-0786</u>			email: ste	ven.pec	k@navy.mil			
Q	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	atment groundwater dat:	a			Good pre- a	nd post-treatme	nt soil data	
	Good pre- and post-tre	-				_ Good pre- a _ Flux assessi	•		
	Groundwater elevation					_ Geologic cr			
	Hydraulic Conductivity								

0215

General Site Information

Impacted	- "	low direction)(ft.): as defined by documentation	Width (ft):	Thick	ness (ft):		Unknown
	 -	ethod for determining size of in		one definition attachmer	nts)		
	Map attachme						
Monitor	Wells: Number of relevan	t monitoring wells with ground	water data:				None
			Pre-treatment:	:	Post-treatment:		
	Number of wells re	lative to treatment zone:					
	Pre-treatmer		Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	nt In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin	igs: Number of relevant	soil borings with pre-treatmen	t data:				
	Number of relevant	soil borings with post-treatment	nt data:				
	Number inside treat	ment zone:	Number outsid	le treatment zone:			
x Types of	Contaminants			1			
					ent Concentration per		ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Chen Groundwater (mg/L)	nical: Soil (mg/kg)	Groundwater (mg/L)	mical: Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	None None	None None	None None	None None
	x Tetrachloroethene	Jet Fuel		None	None	None	None
	x 1,1-dichloroethene	Napthalene		100 mg/L	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	x 1,1-dichloroethane	Ethylbenzene		None	None	None	None
	x 1,2-dichloroethane	m/p-xylene		None	None	None	None
	x 1,1,1-trichloroethane	o-xylene		100 mg/L	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
	x <u>1,2-DCE</u>			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
0							
Comme	erits.						
Attachme	nts:						
	-						

0215

General Site Assessment Data

Hydi	rogeologic Conce	eptual Model	Facility ID#: 0) <u>215</u>
<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>	
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments	
			Relatively homogeneous and impermeable unconsolidated sediments	
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material	
			Largely impermeable sediments with inter-bedded layers of higher permeability material	
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments	
			Relatively homogeneous and impermeable unconsolidated sediments	
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material	
			Largely impermeable sediments with inter-bedded layers of higher permeability material	
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	

Satu	urated Zone:	Weathere Relatively Relatively x Largely in	nt, but fractured bedrock (i.e. d bedrock, limestone, sands homogeneous and permeat homogeneous and imperme ermeable sediments with intempermeable sediments with into the but fractured bedrock (i.e.	tone ole unconsolidated sedime eable unconsolidated sedi er-bedded lenses of lower nter-bedded layers of high	ments permeability material
			d bedrock, limestone, sands		
Ground surface elevation b	ased on wells in o	or adjacent to trea	atment zone:	ft amsl	Unknown
Aquifer Characteristics:					
Is more than 1 aquifer pres	ent?	No Aquifer 1	Yes (number): Aquifer 2	Unkno	own (assume single aquifer)
high	value (ft bgs): value (ft bgs): nown:	7			
Flow direction					
Horizontal hydraulic gradien Vertical hydraulic gradient (,				Unknown
K range (ft/day)	Measured low	using:	Slug Test Lab	oratory	Field data Unknown
Transmissivity (ft2/day):	high Measured Iow high	using:	Slug TestLab	oratory	Field data
Comments:					
Attachments:					

<u>×</u> .	Thermal treatment: Type of Test: Geology of Treatment Zon	X Pilot to	Other (descr	3 phase Steam ibe) x Full		6 phase Steam + air			oower
_		 Pilot to	Steam Other (descr	3 phase Steam ibe) x Full	<u> </u>				oower
_		Pilot to	Other (descr	Steam ibe) <u>x</u> Full	<u> </u>				oower
_		Pilot to	Other (descr	ibe) <u>x</u> Full		Steam + air	Steam -	- 02	
_		Pilot to	est	<u>x</u> Full	-scale Sys			02	
_					l-scale Syst				
<u>x</u>	Geology of Treatment Zon	ie:	<u> </u>	Relatively			de la companya di al	-41	
				D 1 22 1	_	neous and permea			
					_	neous and imperm			
								es of lower permeat	-
								yers of higher perme	eability material
			<u> </u>	-		ctured bedrock (i.e	•	ck)	
	T		<u> </u>			k, limestone, sand		1 137 1	
_	Treatment Targe Zone:		Saturated of	oniy	v	adose only		aturated and Vadose z	
	Start of Thermal Test:		37			_ Duration			
	Hydraulic Control		Yes	No					
<u>x</u> .	Treatment Cell Design:								
,	Size of target zone (ft2):				34400		U	Inknown (x ft)
	Thickness of target zone (ft):			<u>31</u>		U	nknown	
	Depth to top of target zone	e (ft bgs):		<u>5</u>		U	nknown	
	Thickness of target zone belo		ater table (f	t):	<u>29</u>		U	nknown	
1	Number of energy delivery	/ points:			<u>92</u>		U	nknown	
ı	Number of extraction point	ts:			<u>92</u>		U	nknown	
	Temperature Profile:								
	Initial formation temperatu	re (den	C).					Unknown	
	Maximum representative f			ıre (den C	:).			Unknown	
	Time to reach maximum re		•					Unknown	
	Duration of treatment at re	-	•					Unknown	
	Daration of treatment at re	ргозоп	alive tempe	rature (u	ays).			Chknown	
						<u>Da</u>	<u>te</u>	Temperature	(deg C)
	Formation temperature im	mediate	ely post-trea	tment:					
	Formation temperature po	st-treatr	ment monito	ring ever	nt 1:				
	Duration of post-treatment	t monito	ring (days):						
	Mass of contaminant remo	oved:							
			umping:				lb	kg	Unknow
		apor str					lb	kg	Unknow
	Tota	•		_			lb	kg	Unknow
	Comments:								
,	Treating	- 3980	0 yd3						
	informati	ion is b	ased on th	e prelimi	inary des	sign_			A
	Attachments:				-	-			

Cost and Performance Facility ID#: 0215

Periormance						
Remediation Goal:						
<u>x</u>	In Groundwater:					
		<u>Scre</u>	ening analytes in	groundwater to b	elow 10 mg/L	
	In Soil:					
Was the Remediation						
	In Groundwater					
	Comment: —					
						
	In Soil					
	Comment: —					
General comments on	the thermal applicati	ion:				
-						
Lessons Learned						
-						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	kWhr/ye	d^3
Total	energy applied to tre				kWhr/m³	
Other					kWhr/m ³	
		ote other energy:		<u> </u>	_	_
		3,				
Cost						
Total Project Cost:						
Cons	ultant Cost:					
Therr	nal Vendor Cost:					
Energ	y Cost:			_ m³	_ yd³	
· · · · · · · · · · · · · · · · · · ·	Cost 1:					
	Cost 2:					
Other						
Other		Other Cost 1:				
i lease note offic		Other Cost 1:				
		_				
		Other Cost 3:				

General Site Information Facility ID#: 0230 File Analyzed By: Date: PD <u>x</u> 9/13/2006 ____ERH Type of treatment: Conductive ____ Steam Type of Contaminant: _ Chlorinated Solvents Petroleum Hydrocarbons Pesticides ___ Wood Treating Other: **PCBs** <u>X</u> Treatment Status: _Active Post Type of Test: Pilot Test Full Scale System Start of Test: Sep-98 End of Test: Mar-99 Duration: Type of Site: DoD ____Non-DOD <u>X</u> Facility Name: Naval Facility Centerville Beach in Former Transformer Bldg #2 City, State, Zip Code: Ferndale, CA OU# or Site #: Site 6 Primary point of contact: Ralph Baker Organization: TerraTherm Address: 10 Stevens Rd. City, State, Zip Code: Fitchburg, MA 01420 Phone #: 978-343-0300 email: rbaker@terratherm.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data

Flux assessment

Geologic cross-section

____ Good temperature profile vs. time information

___ Hydraulic Conductivity information

____ Groundwater elevations

<u>x</u> Impacted	pacted Zone: Length (parallel to flow direction)(ft.): 30 Width (ft): 40 Thickness (ft): 15 Un x Impacted zone as defined by documentation Alternative method for determining size of impacted zone (See source zone definition attachments) Map attachment						Unknown	
<u>x</u> Monitor V	Vells: Number of relevant m Number of wells relat Pre-treatment Post-treatment	nonitoring wells with ground ive to treatment zone: In:	water data: Pre-treatment: Upgradient: Upgradient:	Downgradient:	·	ssgradient:	<u>χ</u> None	
X Soil Borings: Number of relevant soil borings with pre-treatment data: 2 Number of relevant soil borings with post-treatment data: 16 Number inside treatment zone: 18 Number outside treatment zone:								
					ent Concentration per nical:		ent Concentration per mical:	
F	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None	None	None	None	
	Tetrachloroethene	Jet Fuel	x PCB Aroclor 1254	None	500 mg/kg	None	0.1 mg/kg	
X Types of Co	1,1-dichloroethene	Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	Benzene		None	None	None	None	
	trans-1,2-dichloroethene	Tolune		None	None	None	None	
	1,1-dichloroethane	Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	m/p-xylene		None	None	None	None	
	1,1,1-trichloroethane	o-xylene		None	None	None	None	
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
Comme	Comments: Impacted zone limited to 20 ft bgs							
Attachmen	its:							

0230

General Site Assessment Data

<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sedin	<u>nents</u>					
		Vadose Zone:	Relatively homo	geneous and permeable	unconsolidated sedi	ments			
			Relatively homogeneous and impermeable unconsolidated sediments						
	<u>x</u> Largely permeable sediments with inter-bedded lenses of lower						ity material		
		Largely impermeable sediments with inter-bedded layers of higher permeability mate							
		Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone							
		Saturated Zone:		geneous and permeable		ments			
				geneous and impermeat					
	x Largely permeable sediments with inter-bedded lenses of lower permeability								
Largely impermeable sediments with inter-bet							•		
				fractured bedrock (i.e. cr	•	.g p	,		
			 •	ock, limestone, sandstor	•				
			Waanorda baar	ook, iiinootono, sanastoi					
<u>x</u>	Ground surface elev	vation based on wells in c	or adjacent to treatment	zone:	ft amsl	<u>x</u>	Unknown		
<u>x</u>	Aquifer Characteris	tics:							
	Is more than 1 aquifer present?		Yes	s (number):	<u>x</u> Unk	anown (assume	e single aquifer)		
			Aquifer 1	Aquifer 2	Aquifer 3				
	Depth to water:	low value (ft bgs):	99						
		high value (ft bgs):	<u>145</u>						
		Unknown:							
<u>x</u>	Flow direction		west						
_									
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):				<u>x</u>	Unknown		
	Vertical hydraulic gr	radient (feet/foot):				<u>x</u>	Unknown		
<u>x</u>	K range (ft/day)	Measured	using: Slug	Test Labora	tory	_ Field data			
		low				<u>x</u>	Unknown		
		high							
	Transmissivity (ft2/c	day): Measured	using: Slug	Test Labora	tory	_ Field data			
		low				<u>x</u>	Unknown		
		high				_			
		3							
	Comments:								
	_								
	Attachments:								
	Allaciments								
	_								

The	mal Treatment - D	esign				Facility ID#:	0230
<u>x</u>	Thermal treatmen	nt: <u>x</u> Conductive					
		Electrical R	esistance				
			3 phase	6 phase	AC pow	rer DC po	wer
		Steam					
			Steam	Steam + air	Steam +	O2	
	T (T)	Other (descr					
<u>x</u>	Type of Test:	Pilot test	X Full-scale S	-		ata da a disa auta	
<u>x</u>	Geology of Treat	ment Zone:		geneous and perm			
			-	geneous and impe			lity motorial
		<u>X</u>	• • •			es of lower permeabil yers of higher permea	•
				fractured bedrock			ability material
				ock, limestone, sa		14)	
<u>x</u>	Treatment Targe			Vadose only		aturated and Vadose zo	nes)
<u>x</u>	Start of Thermal	<u> </u>	- , <u>-</u>	-	on: 4 months		,
<u>x</u>	Hydraulic Contro		<u>x</u> No				
<u>x</u>	Treatment Cell D	esign:					
	Size of target zor	ne (ft2):	<u>1200</u>		Uı	nknown (<u>40</u>	x <u>30</u> ft)
	Thickness of targ	et zone (ft):	<u>15</u>		Ui	nknown	
	Depth to top of ta	rget zone (ft bgs):	<u>3</u>		Uı	nknown	
	Thickness of targ	et zone below water table (f	ft): <u>0</u>		Ui	nknown	
	Number of energ	y delivery points:	<u>57</u>		Ui	nknown	
	Number of extract	ction points:	<u>17</u>		Ui	nknown	
<u>x</u>	Temperature Pro	file:					
-	•	emperature (deg C):				<u>x</u> Unknown	
		entative formation temperati	ure (deg C):	360		Unknown	
	•	aximum representative temp		120		Unknown	
	Duration of treatr	nent at representative tempe	erature (days):			<u>x</u> Unknown	
				ļ	<u>Date</u>	Temperature	(deg C)
	Formation tempe	rature immediately post-trea	atment:	Mar-99		<u>360</u>	
	Formation tempe	rature post-treatment monitor	oring event 1:				
	Duration of post-	treatment monitoring (days):	:				
	Mana of annious	t					
<u>x</u>	Mass of contamir				IL.	l. a	Unknown
		Via liquid pumping:			lb		Unknown
		In vapor stream: Total:		402	lb		Unknown
		i otai.		<u>402</u>	<u>x</u> lb	kg	CIIKIIOWII
	Comments:						
		Minimal temperature data	<u></u>				U
		on 6 ft spacings; vacuum	heater wells sp	acing = 10 ft		_	<u>Heaters</u>
	Attachments:						

Cos	t and Performance			Facility ID#:	0230
<u>x</u>	Performance				
_	Remediation Goal:				
	In Grou	indwater.			
	<u>x</u> In Soil:	 Remove PCBs to at or below 	ow applicable regulator and 2. Dioxins and fu	remedial goal. Remedial goars: 2,3,7,8-TCDD TEQ < 1	oal of less than 1.0 .0 ppb
	Was the Remediation Goal Ad	chieved:			
	In Grou	undwater			
	С	Comment:			
	<u>x</u> In Soil				
	С	Comment:			
		1.0 ppm or mg/kg DW wa	s achieved in target tre	eamtne area	
	Canaral assemble on the the	rmal application.			
	General comments on the the	ппагаррисацоп.			
		8,500; mobilization \$30,000; Cons all at \$284.15		emediation \$107,864; Site (general) \$203,750;
			<u></u>		
	Lessons Learned				
	Check for unidentified st	torm drains			
	_ Energy				
	_ Chergy Total Energy Used:		kWhr	kWhr/m³ kW	/br/v/d ³
	<u>.</u>	applied to treatment zone:	KWIII	kWhr/m ³	kWhr/yd ³
	Other energy			kWhr/m ³	kWhr/yd ³
	Other energy	Please note other energy:		KVVIII/III	KVVIII/yu
	_	Flease flote officer energy.			
<u>x</u>	Cost				
	Total Project Cost:	<u>600,351</u>			
	Consultant C	Cost:			
	<u>x</u> Thermal Ven	ndor Cost: <u>600,351</u>			
	Energy Cost:	<u></u>	m ³	yd ³	
	Other Cost 1	:			
	Other Cost 2				
	Other Cost 3	<u></u>			
	Please note other cost:	Other Cost 1:			
		Other Cost 2:			

___ Other Cost 3:

File Analyzed By: JT <u>x</u> PD ____ Date: 10/31/2006 ____Steam ____Other: Type of treatment: ___ Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents _ Petroleum Hydrocarbons ____ Wood Treating _Other: Treatment Status: ____ Active Post X Type of Test: ____ Pilot Test Full Scale System X Start of Test: End of Test: _____ Duration: _____ Type of Site: ____DoD Non-DOD Facility Name: Former Union Pacific Railroad Address: City, State, Zip Code: Long Beach, CA OU# or Site #: Primary point of contact: Jay Dablow Organization: **ERM** Address: 3 Hutton Centre, Suite 600 City, State, Zip Code: Santa Ana, CA 92707 Phone #: 714-430-1476 email: jay.dablow@erm.com Other contacts or vendors who worked on site _ None Point of contact: Jim Levy Type: ___ Vendor, Consultant ____ Vendor, Technical Applications ____Other Organization: <u>Union Pacific Railroad Company</u> Address: City, State, Zip Code: Rosedale, CA Phone #: _____ email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0235

General Site Information

_____ Hydraulic Conductivity information

Impacted	- "	w direction)(ft.):as defined by documentation	Width (ft):	Thick	ness (ft):	_	Unknown	
	Alternative method for determining size of impacted zone (See source zone definition attachments) Map attachment							
Monitor Wells: Number of relevant monitoring wells with groundwater data: None Pre-treatment: Post-treatment:							None	
Number of wells relative to treatment zone:								
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:					
	Number of relevant so	oil borings with post-treatmer	nt data:					
	Number inside treatme			e treatment zone:				
x Types of C	Contaminants							
				Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None	None	None	None	
	Tetrachloroethene	Jet Fuel		None	None	None	None	
	1,1-dichloroethene	Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	x Benzene		None	None	None	None	
	trans-1,2-dichloroethene	x Tolune		None	None	None	None	
	1,1-dichloroethane	<u>x</u> Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	x m/p-xylene		None	None	None	None	
	1,1,1-trichloroethane	x o-xylene		None	None	None	None	
Chemicals of Concern	1,1,2-trichloroethane	x trimethylbenzenes		None	None	None	None	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
		·		•				
Comme	nts:							
Attachmen	nts:							
	-							

0235

General Site Assessment Data

Hydrogeologic Conceptual Model

X Geology: Zone
Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments
Relatively homogeneous and impermeable unconsolidated sediments
Relatively homogeneous and impermeable unconsolidated sediments
Largely permeable sediments with inter-bedded lenses of lower permeability material
Largely impermeable sediments with inter-bedded layers of higher permeability material
Competent, but fractured bedrock (i.e. crystalline rock)
Weathered bedrock, limestone, sandstone
Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments

			Largery imperme	able scallicitis with the	cr bedded layers or riigh	ici perincability material
			Competent, but t	ractured bedrock (i.e. c	rystalline rock)	
			Weathered bedr	ock, limestone, sandsto	ne	
		Saturated Zone:	Relatively homo	geneous and permeable	e unconsolidated sedime	ents
			Relatively homo	geneous and impermea	ble unconsolidated sedi	ments
			<u>x</u> Largely permeat	le sediments with inter-	bedded lenses of lower	permeability material
			Largely imperme	eable sediments with inte	er-bedded layers of high	er permeability material
			Competent, but	ractured bedrock (i.e. c	rystalline rock)	
			Weathered bedr	ock, limestone, sandsto	ne	
	_ Ground surface ele	evation based on wells	s in or adjacent to treatment	zone:	ft amsl	Unknown
<u>x</u>	Aquifer Characteris	stics:				
	Is more than 1 aqu	ifer present?	No Yes	(number):	Unkno	wn (assume single aquifer)
			Aquifer 1	Aquifer 2	Aquifer 3	
	Depth to water:	low value (ft bgs):	<u>10</u>			
		high value (ft bgs)):			
		Unknown:				
	Flow direction					
	_ Horizontal hydrauli	c gradient (feet/foot):				Unknown
	Vertical hydraulic g	gradient (feet/foot):				Unknown
	_ K range (ft/day)	Measu	ured using: Slug	TestLabor	atoryI	Field data
		low				Unknown
		high				
	Transmissivity (ft2/	'day): Measu	ured using: Slug	Test Labor	atoryI	Field data
		low				Unknown
		high				
	<u> </u>					
	Comments:					
	_					
	=					
	Attachments: _					
	_					

The	rmal Treatment - Design				Facility ID#:	<u>0235</u>
<u>x</u>	Thermal treatment:	Conductive				
		Electrical Resista	ance			
		3 ph	ase 6 phase	se AC	power D	C power
		x Steam SVE	enhanced steam in jection	L		
		Stea	m Steam	+ air Ste	am + O2	
		Other (describe)				
<u>x</u>	Type of Test:	Pilot test <u>x</u>	Full-scale System			
<u>x</u>	Geology of Treatment Zon	ne: Rela	atively homogeneous an	d permeable uncons	olidated sediments	
		Rela	atively homogeneous an	d impermeable unco	nsolidated sediments	i
		<u>x</u> Larç	gely permeable sedimen	ts with inter-bedded	lenses of lower perm	eability material
		Larç	gely impermeable sedim	ents with inter-bedde	ed layers of higher pe	rmeability material
		Con	npetent, but fractured be	drock (i.e. crystalline	e rock)	
		Wea	athered bedrock, limesto	ne, sandstone		
	_Treatment Targe Zone:	Saturated only	Vadose only	Bot	th (Saturated and Vados	e zones)
	_Start of Thermal Test:			Duration:		
	_ Hydraulic Control	Yes	_ No			
-	_ Treatment Cell Design:					
	Size of target zone (ft2):	400	-		Unknown (_ x ft)
	Thickness of target zone				Unknown	
	Depth to top of target zon				Unknown	
	Thickness of target zone				Unknown	
	Number of energy deliver				_ Unknown	
	Number of extraction poir	its.			Unknown	
	_ Temperature Profile:					
	Initial formation temperate	ure (dea C):			Unknow	n.
	Maximum representative		 dea C):		Unknow	
	Time to reach maximum r		- '		Unknow	
	Duration of treatment at re				Unknow	
		- F			<u> </u>	
				<u>Date</u>	Temperat	ure (deg C)
	Formation temperature im	nmediately post-treatme	nt:			
	Formation temperature po	ost-treatment monitoring	event 1:			
	Duration of post-treatmen	t monitoring (days):				
<u>x</u>	Mass of contaminant rem	oved:				
	Via	a liquid pumping:		lb	kg	Unknow
	In	vapor stream:		lb	kg	Unknow
	To	tal:	<u>60000</u>	<u>x</u> lb	kg	Unknow
	Comments:					
	Attach mants:				-	
	Attachments:					

and Performance					Facility ID#:	<u>0235</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_						
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Whr/vd ³
	tal energy applied to t	reatment zone.			kWhr/m³	kWhr/yc
	her energy:				_ kWhr/m³	kWhr/yo
					_ KVVIII/III	KVVIII/yC
	Please	note other energy:	-			
Cost						
Total Project Cost:						
-	nsultant Cost:					
	ermal Vendor Cost:					
	ergy Cost:			m ³	_ yd³	
					_ yu	
	her Cost 1:	-				
	her Cost 2:					
·	her Cost 3:					
Please note of	ther cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

x File Analyzed By: JT	<u>x</u> PD				Date:	10/30/2006
Type of treatment:	<u>x</u> Conductive	Steam	ERH	Other:		
Type of Contaminant:	<u>x</u> Chlorinated Solv	ents	Petroleum Hydroca	rbons	Pesticides	
	Wood Treating	_	Other:			
Treatment Status:	Active	$\underline{\mathbf{x}}$ Post				
Type of Test:	Pilot Test	x Full Scal	e System			
Start of Test:	6/13/2005	End	of Test: 7-Oct		Duration: 116	<u>d</u>
Type of Site:	x Non-DOD	DoD				
x Facility Name: Richmond,	CA					
Address:						_
City, State, Zip Code:	Richmond, CA					
OU# or Site #: Terminal 1	site					
Y Primary point of contact:	Ralph Baker					
Organization: <u>TerraTherm</u>	<u> </u>					
Address: 10 Stevens Road						
City, State, Zip Code:	Fitchburg, MA 01420					
Phone #: 978-343-0300		email: rba	ker@terratherm.com			
Other contacts or vendors who	o worked on site		None			
Point of contact: Frank	Szerdy					
Type: <u>x</u> Vendor, Co	nsultant	_Vendor, Techn	ical Applications	Oth	er	
Organization: Geomatrix	Consultants, Inc					
Address: 210 Webster St. 1	12th Fl.					
City, State, Zip Code:	Oakland, CA 94612					
Phone #: <u>510-663-4100</u>		email: Fse	erdy@geomatrix.com			
QA/QC						
Characteristics of Interest						
Good pre- and post-trea	tment groundwater data	ı	Good pre- an	d post-treatmer	nt soil data	
Good temperature profil	le vs. time information		Flux assessm	ent		
Groundwater elevations			Geologic cro	ss-section		
Hydraulic Conductivity	information					

0238

General Site Information

x Impacted Zone: Length (parallel to flow direction)(ft.): 65 Width (ft): 150 Thickness (ft): Unknown 20 ____ Impacted zone as defined by documentation ____ Alternative method for determining size of impacted zone (See source zone definition attachments) ____ Map attachment ___ Monitor Wells: Number of relevant monitoring wells with groundwater data: X None Pre-treatment: Post-treatment: _ Number of wells relative to treatment zone: Upgradient: _____ Pre-treatment In: _____ Downgradient: ____ Crossgradient: __ Upgradient: Post-treatment In: _____ Downgradient: _____ Crossgradient: x Soil Borings: Number of relevant soil borings with pre-treatment data: 17 Number of relevant soil borings with post-treatment data: 64 Number inside treatment zone: 64 Number outside treatment zone: Types of Contaminants Average Pre-treatment Concentration per Average Post-treatment Concentration per Chemical: Chemical: Chlorinated Solvents Other Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L) Soil (mg/kg) Petroleum Hydrocarbons Trichloroethene Hexane Creosote None 1 mg/kg None 0.01 mg/kg ___ Jet Fuel Tetrachloroethene None 50 mg/kg None 0.01 mg/kg 1,1-dichloroethene ___ Napthalene None None None None cis-1,2-dichloroethene 0.05 mg/kg Benzene None 10 mg/kg None _ trans-1,2-dichloroethene Tolune None None None None ___1,1-dichloroethane Ethylbenzene None None None None ____1,2-dichloroethane None ___ m/p-xylene None None None ___1,1,1-trichloroethane __o-xylene None None None None Chemicals of ___1,1,2-trichloroethane None None None None Concern _ 1,1,2,2-tetrachloroethane None None None None Vinyl Chloride None 1 mg/kg None 0.01 mg/kg None Comments: Attachments:

Facility ID#:

0238

General Site Assessment Data

		high value (ft bgs):	<u>4</u>			
		Unknown:				
	_ Flow direction					
	_ Horizontal hydraulic g	radient (feet/foot):				Unknown
	Vertical hydraulic grad	dient (feet/foot):				Unknown
<u>(</u>	K range (ft/day)	Measured	using: Sluç	g TestLabo	oratory	_ Field data
		low	0.0003			Unknown
		high				
	Transmissivity (ft2/day	y): Measured	using: Slug	TestLabo	oratory	Field data
		low				Unknown
		high				
	Comments:					

Attachments:

Electrical Resistance	The	rmal Treatment - Design							Facility ID#:	0238
Steam Steam Steam Steam AC power DC power Steam Steam - AC power DC power - Steam - Steam - Steam - Steam - Steam - Steam + air Steam + O2 - Steam - Other (describe) Z Type of Test: Plot test X Full-scale System - Oz - Plot Kindows - Plot Kindows - Oz - Plot Kindows - Plot X Full-scale System - Oz - Pl	<u>x</u>	Thermal treatment:	_		itu Thermal	Desorption				
Type of Test:			_			_ 6 phase		_ AC power	DO	. power
Y Type of Test:Pilot lest Fill-scale System			_		_	Steam + air	r	_ Steam + O	2	
Geology of Treatment Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock, (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Treatment Targe Zone: Saturated only Vadose only Neathered bedrock, limestone, sandstone Treatment Targe Zone: Start of Thermal Test: 613-2005 Duration: 116 d 117 d 117 d 118 d	х	Type of Test:			-scale Syste	m				
Largely permeable sediments with inter-bedded lenses of lower permeability material x Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) weathered bedrock, limestone, sandstone x Treatment Targe Zone: Saturated only Vadosc only x Both (Saturated and Vadosc zones) x Start of Thermal Test: 6/13/2005 Duration: 116.4 x Treatment Cell Design: Size of target zone (ft2): 9450 Unknown Size of target zone (ft2): 9450 Unknown Depth to top of target zone (ft bgs): 0 Unknown Depth to top of target zone (ft bgs): 12 Unknown Number of energy delivery points: 138 Unknown Number of energy delivery points: 12 Unknown Temperature Profile: Unknown Time to reach maximum representative temperature (deg C): 100 Unknown Duration of treatment at representative temperature (days): 10 Unknown Duration of treatment at representative temperature (days): 10 Unknown Duration of post-treatment monitoring event 1: Unknown Mass of contaminant removed: Via liquid pumping: 10 Unknown Total: 10 Via liquid pumping: 10 Via liquid pumpi	<u>x</u>		_	_	-		rmeable ur	nconsolidate	ed sediments	
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestones sandstone X Treatment Targe Zone: Saturated only Vadose only X			_	Relatively	/ homogen	eous and imp	permeable	unconsolida	ated sediments	
Competent, but fractured bedrock (i.e. crystalline rock)Weathered bedrock, limestone, sandstone x Treatment Targe Zone:Saturated onlyVadosc only Both (Saturated and Vadose zones) x Start of Thermal Test:			_	Largely p	ermeable s	sediments wi	th inter-be	dded lenses	of lower perme	ability material
Weathered bedrock, limestone, sandstone X Treatment Targe Zone:Saturated only			<u>x</u>	Largely in	mpermeabl	e sediments	with inter-l	edded laye	rs of higher per	meability material
X Treatment Targe Zone:Saturated onlyVadose only _X Both (Saturated and Vadose zones) X Start of Thermal Test:6/13/2005			_	Compete	nt, but frac	tured bedroc	k (i.e. crys	talline rock)		
Start of Thermal Test: 613/2005 Duration: 116 d Hydraulic Control Yes X No Treatment Cell Design: Size of target zone (ft2): 9450 Unknown Depth to top of target zone (ft9): 0 Unknown Thickness of target zone (ft bgs): 0 Unknown Number of energy delivery points: 138 Unknown Number of energy delivery points: 12 Unknown Temperature Profile: Initial formation temperature (deg C): 10 Unknown Time to reach maximum representative temperature (days): 110 Unknown Duration of treatment at representative temperature (days): 110 Unknown Duration of treatment at representative temperature (days): 100 Unknown Duration of post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: 1 b kg Unknown Total: 12 tt spacing of heater wells			_	Weather	ed bedrock	, limestone, s	sandstone			
X Hydraulic ControlYes X No X Treatment Cell Design: Size of target zone (ft2): 9450	<u>x</u>	Treatment Targe Zone:	Saturate	ed only	Va	dose only	<u>x</u>	Both (Satu	rated and Vadose	zones)
X Treatment Cell Design: Size of target zone (ft2): 9450	<u>x</u>	Start of Thermal Test:	6/13/2005			Dura	ation: <u>116</u>	<u>d</u>		
Size of target zone (ft2): 9450 Unknown Unknown Unknown Unknown Unknown Number of energy delivery points: Initial formation temperature (deg C): Initial formation temperature immediately post-treatment: Duration of post-treatment monitoring days): Mass of contaminant removed: Via liquid pumping: In vapor stream: 6000 Value of target zone (ft bgs): Unknown In vapor stream: 6000 X Ib _ kg _ Unknown In vapor stream: 10 kg _ Unknown Un	<u>x</u>	Hydraulic Control	Yes	<u>X</u> No						
Thickness of target zone (ft): Depth to top of target zone (ft bgs): Depth to top of target zone below water table (ft): Is Unknown Number of energy delivery points: Is Unknown Number of extraction points: It Unknown Number of extraction points: It Unknown Maximum representative formation temperature (deg C): If Unknown Maximum representative formation temperature (days): Duration of treatment at representative temperature (days): Duration of treatment at representative temperature (days): Formation temperature immediately post-treatment: Duration of post-treatment monitoring (days): Wass of contaminant removed: Via liquid pumping: In vapor stream: I	<u>x</u>	Treatment Cell Design:								
Depth to top of target zone (ft bgs): Depth to top of target zone below water table (ft): 18		Size of target zone (ft2):			<u>9450</u>			Unk	nown (_ x ft)
Thickness of target zone below water table (ft): 18		Thickness of target zone (i	ft):		<u>20</u>			Unk	nown	
Number of energy delivery points: 138Unknown Number of extraction points: 12Unknown X Temperature Profile: Initial formation temperature (deg C): 17Unknown Maximum representative formation temperature (deg C): 100Unknown Time to reach maximum representative temperature (days): 110Unknown Duration of treatment at representative temperature (days): 6Unknown Date		Depth to top of target zone	(ft bgs):		<u>0</u>			Unk	nown	
Number of extraction points: 12		_		e (ft):				· · · · · · · · · · · · · · · · · · ·		
Temperature Profile: Initial formation temperature (deg C): 17			·					<u> </u>		
Initial formation temperature (deg C): 17		Number of extraction point	.S:		<u>12</u>			Unk	nown	
Maximum representative formation temperature (deg C): 100 Unknown Time to reach maximum representative temperature (days): 110 Unknown Duration of treatment at representative temperature (days): 6 Unknown Date	<u>x</u>	Temperature Profile:								
Time to reach maximum representative temperature (days): 110		•				<u>17</u>				
Duration of treatment at representative temperature (days): Date Temperature (deg C)		·	•			<u>100</u>			Unknown	1
Formation temperature immediately post-treatment: 10/8/2005 100 Formation temperature post-treatment monitoring event 1:			•	. ,	• /					
Formation temperature immediately post-treatment: 10/8/2005 100 Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping:		Duration of treatment at re	presentative ter	mperature (d	ays):	<u>6</u>			Unknow	1
Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Comments: 12 ft spacing of heater wells							<u>Date</u>		·	re (deg C)
Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Comments: 12 ft spacing of heater wells		•				10/8/2005			<u>100</u>	
X Mass of contaminant removed: Via liquid pumping:				_	nt 1:					
Via liquid pumping:		Duration of post-treatment	monitoring (day	ys):						
In vapor stream: 6000 X lbkg Unknown Total: lbkg Unknown Comments: 12 ft spacing of heater wells	<u>x</u>									
Total:lbkgUnknown Comments: 12 ft spacing of heater wells								<u> </u>		· <u></u>
Comments: 12 ft spacing of heater wells			•		<u>600</u>	<u>)0</u>				
12 ft spacing of heater wells		I ota	al:					_ lb	kg	Unknown
		Comments:								
Attachments:		<u>12 ft spa</u>	cing of heater	wells						
		Attachments:								

Cost and Performance Facility ID#: 0238

<u>x</u>	Performance			
	Remediation Goal:			
	In Groundwate	er:		
	X In Soil:	PCE =2 mg/kg TC	CE = 2mg/kg	ng/kg
	Was the Remediation Goal Achieved:	:		
	In Groundwate	er		
		ıt:		
	X In Soil			
	— Commen	nt:		
		PCE = 0.012 mg/kg TCE = NE	DCE = 0.065 mg/kg VC = 0.005 mg/	ka
				<u> </u>
	General comments on the thermal ap	plication:		
	Lessons Learned			
	_			
<u>x</u>	Energy			
) kWhr/yd ³
	Total energy applied	I to treatment zone:	kWhr/m ³	
	Other energy:		kWhr/m ³	kWhr/yd ³
	Ple	ase note other energy:		
.,	Cook			
<u>X</u>	Cost			
	Total Project Cost:			
	Consultant Cost:		_	
	<u>x</u> Thermal Vendor Cos	st: <u>1,770,000</u>		
	x Energy Cost:	<u>400,000</u>	$_{}$ m ³ $\frac{$310}{}$ yd ³	
	Other Cost 1:		<u> </u>	
	Other Cost 2:		_	
	Other Cost 3:		_	
	Please note other cost:	Other Cost 1:		
		Other Cost 2:		
		Other Cost 3:		·

File Analyzed By: Date: PD ___ 9/22/2006 Type of treatment: Conductive Steam ERH ____Other: Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Pesticides Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: 9/11/1999 End of Test: 4/14/2000 Duration: 113 days Type of Site: DoD ___Non-DOD <u>X</u> Facility Name: North Island NAS (Pilot) Address: City, State, Zip Code: Coronado, CA OU# or Site #: IR Site 9 Area 1 Primary point of contact: Michael Pound Organization: Address: City, State, Zip Code: Phone #: <u>619-556-9901</u> email: michael.pound@navy.mil Other contacts or vendors who worked on site _ None Point of contact: Richard Wong Type: Vendor, Consultant ___ Vendor, Technical Applications __Other Organization: Shaw Address: City, State, Zip Code: Phone #: 619-437-6328 x314 email: richard.wong@shawgrp.com QA/QC ___ Characteristics of Interest ___ Good pre- and post-treatment groundwater data __Good pre- and post-treatment soil data ____ Good temperature profile vs. time information _ Flux assessment ___ Groundwater elevations _Geologic cross-section

Facility ID#:

0240

General Site Information

___ Hydraulic Conductivity information

<u>x</u>	Impacted	Zone:		w direction)(ft.): 1000 as defined by documentation and for determining size of im	ı	lth (ft): (See source zoi		kness (ft):	12	Unknov	vn
			Map attachment	t							
<u>x</u>	Monitor V	Vells:	Number of relevant n	nonitoring wells with ground	water data:					None	
Pre-treatment: 3 Post-treatment:											
	Number of wells relative to treatment zone:										
			Pre-treatment	In: <u>3</u>	Upgradien		Downgradient:	· ·	Crossgradient:		
			Post-treatment	In:	Upgradien	t:	Downgradient:		Crossgradient:		
	Soil Boring	gs:		oil borings with pre-treatment							
				oil borings with post-treatmer	-						
			Number inside treatm	ent zone:	^	Number outside	treatment zone:				
	_										
X	Types of C	Contamina	nts					nent Concentration pe		nent Concentration	on per
		Cl	nlorinated Solvents	Petroleum Hydrocarbons	0	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/	/kø)
			chloroethene	Hexane	Creosot		None	None	None	None	8/
		Г	rachloroethene	Jet Fuel			None	None	None	None	
			dichloroethene	Napthalene			None	None	None	None	
		x cis-	1,2-dichloroethene	x Benzene			None	None	None	None	
			s-1,2-dichloroethene	x Tolune			None	None	None	None	
			dichloroethane	<u>x</u> Ethylbenzene			None	None	None	None	
			dichloroethane	x m/p-xylene			None	None	None	None	
		x 1,1,	1-trichloroethane	x o-xylene			None	None	None	None	
	emicals of Concern	<u>x</u> 1,1,	2-trichloroethane				None	None	None	None	
		1,1,	2,2-tetrachloroethane				None	None	None	None	
		x Vin	yl Chloride				None	None	None	None	
							None	None	None	None	
							None	None	None	None	
							None	None	None	None	
							None	None	None	None	
							None	None	None	None	
							None	None	None	None	
	Comme	nts:			_						
		_									
		_			_						
		_									
	Attachmer	nts:									
		_									

0240

General Site Assessment Data

Hydr	ogeologic Conceptual N	Model						Facility ID#:	0240
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relativel X Largely i Largely i Compete Weather Relativel Relativel X Largely i Compete	y homo y homo permeal mperme ent, but ed bedr y homo y homo permeal mperme ent, but	geneous and geneous and ole sediment pable sediment fractured belook, limestor geneous and geneous and ole sediment eable sediment	d impermeable of swith inter-bed ents with inter-bed drock (i.e. crystane, sandstone dispermeable of impermeable of swith inter-bed impermeable of swith inter-bed	consolidated sed unconsolidated s ded lenses of lov edded layers of h	ediments ver permeability nigher permeab iments ediments ver permeability	ility material
<u>x</u>	Ground surface elevat	ion based on wells in o	r adjacent to tre	atment	zone:	10 (aMLLW)	ft amsl	t	Jnknown
<u>x</u>	Aquifer Characteristics		N	37	· (1 -)		11.1		
	Is more than 1 aquifer	present?	No Aquifer 1	1e	Aqui	 fer 2	<u>x</u> Unl Aquifer 3	known (assume s	ingle aquiler)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	<u>8</u> <u>10</u>						
<u>x</u>	Flow direction		WNW						
X	Horizontal hydraulic grad		0.0004 to 0.000	<u>7</u>					Jnknown Jnknown
X	K range (ft/day)	Measured low high	using: 0.052 0.091	Slug	Test	Laboratory	·	Field data U	Jnknown
	Transmissivity (ft2/day	v): Measured low	using:	_ Slug	Test	Laboratory		Field data	Jnknown

Comments:

	aMLLW - above mean low level sea water
Attachments:	

The	mal Treatment - Design								Facility ID#:	0240
<u>x</u>	Thermal treatment:	_	_ Conductive							
		_	_ Electrical F	Resistance						
				3 phase		6 phase		AC powe	er D	OC power
		<u>x</u>	Steam							
			<u>x</u>	Steam		Steam + air		_Steam + 0	O2	
			Other (desc	cribe)						
<u>x</u>	Type of Test: \underline{x}	Pilot	test	Full-	scale System					
<u>x</u>	Geology of Treatment Zone	э:		Relatively	homogene	ous and permeat	ble un	consolidat	ted sediments	
				Relatively	homogene	ous and imperme	eable	unconsolio	dated sediments	3
			<u>x</u>	Largely pe	ermeable se	diments with inte	er-bed	ded lense	s of lower perm	eability material
				_Largely in	npermeable	sediments with i	nter-b	edded lay	ers of higher pe	rmeability material
				Competer	nt, but fractu	red bedrock (i.e.	cryst	alline rock)	
				Weathere	d bedrock, l	imestone, sands	tone			
<u>x</u>	Treatment Targe Zone:		_ Saturated	only	Vado	se only	<u>x</u>	Both (Sat	urated and Vado	se zones)
<u>x</u>	Start of Thermal Test:	9/11	/1999			Duration:	113	days		
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No						
v	Treatment Cell Design:									
<u>x</u>	Size of target zone (ft2):				<u>7853</u>			Un	known (_	x ft)
	Thickness of target zone (fr	٤١٠						Un	-	_ ^ _ 11)
	Depth to top of target zone		ic).		<u>8</u> <u>6</u>			Un		
	Thickness of target zone be			'f+\·	<u>u</u> <u>4</u>				known	
	Number of energy delivery			,it).	<u>4</u> <u>6</u>				known	
			5.							
	Number of extraction points	5.			<u>12</u>				known	
<u>x</u>	Temperature Profile:									
	Initial formation temperatur	e (de	g C):			<u>21</u>			Unknow	vn
	Maximum representative for	rmati	on tempera	ture (deg C):	<u>104</u>			Unknow	vn
	Time to reach maximum re	prese	ntative tem	perature (da	ays):	<u>20</u>			Unknow	vn
	Duration of treatment at rep	oresei	ntative temp	erature (da	ays):	<u>49</u>			Unknow	vn
						Date	e		Tempera	ture (deg C)
	Formation temperature imr	nedia	tely post-tre	atment:		· <u></u>	_			
	Formation temperature pos				t 1:				_	
	Duration of post-treatment			ū						
<u>x</u>	Mass of contaminant remo		pumping:		1460)	~	lb	kα	Unknow
		•	tream:				<u>x</u>	lb	kg	Unknow
	Tota		ileaiii.		1400		<u>x</u>		kg	Unknow
	Tota	u.			2860	<u>.</u>	<u>X</u>	lb	kg	Unknow
	Comments:									
	<u></u>									
	Attachments:									

Cost and Performance Facility ID#: 0240

Remediation Goal:		
<u>x</u>		
	In Groundwater:	
		See how long and if could reach 170F, the boiling point of TCE
	In Soil:	
Was the Remediation		
	In Groundwater	
	Comment: —	
	_	
	In Soil	
	Comment: —	
General comments on	the thermal applica	tion:
		
Lessons Learned		
Lessons Learned		
		kWhrkWhr/m³kWhr/yd³
Total Energy Used:	energy applied to tr	reatment zone:kWhr/m ³ kWhr/yo
Energy Total Energy Used:TotalOther		reatment zone: kWhr/m³ kWhr/yo
Total Energy Used: Total	r energy:	reatment zone:kWhr/m ³ kWhr/yo
Total Energy Used: Total Other	r energy:	reatment zone:kWhr/m³kWhr/yo
Total Energy Used: Total Other Cost	r energy:	reatment zone:kWhr/m³kWhr/yo
Total Energy Used: Total Other Cost Total Project Cost:	r energy: Please r	reatment zone:kWhr/m³kWhr/yo
Total Energy Used: Total Other Cost Total Project Cost:	r energy:	reatment zone:kWhr/m³kWhr/yo
Total Energy Used: Total Other Cost Total Project Cost: Consults	r energy: Please r	reatment zone:kWhr/m³kWhr/yokWhr/m³kWhr/yo note other energy:
Total Energy Used: Total Other Cost Total Project Cost: Consi	r energy: Please r	reatment zone:kWhr/m³kWhr/yo
Total Energy Used:	r energy: Please r Lultant Cost: mal Vendor Cost:	reatment zone:kWhr/m³kWhr/yokWhr/m³kWhr/yo note other energy:
Total Energy Used: Total Other Cost Total Project Cost: Consi Therm Energ Other	r energy: Please r ultant Cost: mal Vendor Cost: gy Cost:	reatment zone:kWhr/m³kWhr/yokWhr/m³kWhr/yo note other energy:
Total Energy Used: Total Other Cost Total Project Cost: Consi Therm Energy Other	r energy: Please r ultant Cost: mal Vendor Cost: gy Cost: r Cost 1:	reatment zone: kWhr/m³kWhr/yckWhr/m³kWhr/yc note other energy:
Total Energy Used: Total Other Cost Total Project Cost: Consi Fherm Energy Other	r energy: Please r ultant Cost: mal Vendor Cost: gy Cost: r Cost 1: r Cost 2: r Cost 3:	reatment zone: kWhr/m³kWhr/yckwhr/m³kWhr/yc
Total Energy Used: Total Other Cost Total Project Cost: Consu Therm Energy Other	r energy: Please r ultant Cost: mal Vendor Cost: gy Cost: r Cost 1: r Cost 2: r Cost 3:	reatment zone:kWhr/m³kWhr/yokWhr/m³kWhr/yo note other energy:

Facility ID#: 0245 File Analyzed By: Date: PD ___ 9/22/2006 Type of treatment: Conductive Steam ERH ____Other: ___ Pesticides Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: 9/11/1999 End of Test: 4/14/2000 Duration: 113 days Type of Site: DoD ___Non-DOD <u>X</u> Facility Name: North Island NAS Address: City, State, Zip Code: Coronado, CA OU# or Site #: IR Site 9 Area 1 Primary point of contact: Michael Pound Organization: Address: City, State, Zip Code: Phone #: <u>619-556-9901</u> email: michael.pound@navy.mil Other contacts or vendors who worked on site _None Point of contact: Richard Wong Type: Vendor, Consultant ___ Vendor, Technical Applications __Other Organization: Shaw Address: City, State, Zip Code: Phone #: 619-437-6328 x314 email: richard.wong@shawgrp.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data ___ Good temperature profile vs. time information Flux assessment ___ Groundwater elevations Geologic cross-section

General Site Information

Hydraulic Conductivity information

General Site A	Assessment	Data					Facility I	ID#: <u>0245</u>
<u>x</u> Impacte	d Zone:	Length (parallel to flow	w direction)(ft.): 1000	Width (ft):	<u>500</u> Th	ickness (ft): 1	12	Unknown
		Impacted zone a	as defined by documentatio	n				
		<u>x</u> Alternative method	hod for determining size of i	mpacted zone (See source	zone definition attachm	nents)		
		Map attachment	t					
<u>x</u> Monitor	Wells:	Number of relevant r	monitoring wells with ground	dwater data:				None
				Pre-treatmen	t: <u>8</u>	Post-treatment:	<u>8</u>	
			tive to treatment zone:					
		Pre-treatment	In: <u>8</u>	Upgradient:	Downgradien		Prossgradient:	
		Post-treatment	In:	Upgradient:	Downgradien	t: C	Crossgradient:	
x Soil Bori	ngs:		oil borings with pre-treatmen		<u>)</u>			
		Number of relevant so	oil borings with post-treatme	ent data: 12	<u>6</u>			
		Number inside treatm	nent zone: 20/126	Number outsi	de treatment zone:	<u>0</u>		
x Types of	Contamina	ants		1				
						ment Concentration per nemical:		ment Concentration per emical:
	C	hlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L) Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	<u>x</u> Tri	chloroethene	Hexane	Creosote	None	5,000 mg/kg	None	5 mg/kg
	x Tet	trachloroethene	Jet Fuel		None	100 mg/kg	None	5 mg/kg
	<u>x</u> 1,1	-dichloroethene	Napthalene		None	500 mg/kg	None	0.1 mg/kg
	x cis-	-1,2-dichloroethene	Benzene		None	100 mg/kg	None	0.5 mg/kg
	trai	ns-1,2-dichloroethene	x Tolune		None	500 mg/kg	None	5 mg/kg
	<u>x</u> 1,1	-dichloroethane	Ethylbenzene		None	100 mg/kg	None	0.1 mg/kg
	<u>x</u> 1,2	-dichloroethane	m/p-xylene		None	100 mg/kg	None	0.1 mg/kg
Chemicals of	<u>x</u> 1,1	,1-trichloroethane	o-xylene		None	1,000 mg/kg	None	0.1 mg/kg
Concern		,2-trichloroethane			None	100 mg/kg	None	0.1 mg/kg
	1,1	,2,2-tetrachloroethane	x NFSO		None	None	None	None
	<u>x</u> Vii	nyl Chloride			None	100 mg/kg	None	0.1 mg/kg
			x <u>Benzene</u>		None	100 mg/kg	None	0.5 mg/kg
			x MTBE		None	100 mg/kg	None	0.1 mg/kg
			x Ethylbenzene		None	100 mg/kg	None	1 mg/kg
			x MeCl2		None	100 mg/kg	None	0.1 mg/kg
			x 4-methyl-2-pentanone		None	1,000 mg/kg	None	0.5 mg/kg
			x Total xylenes		None	100 mg/kg	None	10 mg/kg
Comn								
Comm	ienis.							
				Con attached	sheets for the number	250		
				See allached	anders for the number	<u> </u>		
Attachm	ente:							
Allachm	- LIIIS. —							
	_							
	_							

Hydrogeologic Concepto	ual Model	Facility ID#:	0245
0 1	-		

<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>							
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments							
			Relatively homogeneous and impermeable unconsolidated sediments							
			x Largely permeable sediments with inter-bedded lenses of lower permeability material							
			Largely impermeable sediments with inter-bedded layers of higher permeability material							
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments							
			Relatively homogeneous and impermeable unconsolidated sediments							
			x Largely permeable sediments with inter-bedded lenses of lower permeability material							
			Largely impermeable sediments with inter-bedded layers of higher permeability material							
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
<u>x</u>	Ground surface ele	vation based on wells in o	or adjacent to treatment zone: 10 (aMLLW) ft amsl Unknown							
<u>x</u>	Aquifer Characteris	tics:								
	Is more than 1 aqui	fer present?	No Yes (number): X Unknown (assume single aquifer)							
			Aquifer 1 Aquifer 2 Aquifer 3							
	Depth to water:	low value (ft bgs):	<u> </u>							
		high value (ft bgs):	<u>10</u>							
		Unknown:								
<u>x</u>	Flow direction		<u>WNW</u>							
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):	<u>0.0004 to 0.0007</u> Unknown							
	Vertical hydraulic g	radient (feet/foot):	Unknown							
<u>x</u>	K range (ft/day)	Measured	l using: Slug Test Laboratory Field data							
		low	<u>0.052</u> Unknown							
		high	0.091							
	Transmissivity (ft2/	day): Measured	l using: Slug Test Laboratory Field data							
		low	<u>X</u> Unknown							
		high								
	Comments:									
	<u>al</u>	MLLW - above mean lo	w level sea water							
	Attachments:									
	_									
	_									

The	rmal Treatment - Design								Facility ID#:	<u>0245</u>
<u>x</u>	Thermal treatment:		Conductiv	re						
		1	Electrical	Resistance						
		<u>x</u> :	Steam	_ 3 phase		6 phase		_AC powe	er Do	C power
		_	<u>x</u>	Steam		Steam + air		_ Steam + 0	O2	
	Type of Test:		Other (des		anala Creatam					
<u>x</u>	Geology of Treatment Zone	Pilot te		_	scale Systen		ooblo un	consolidat	ted sediments	
<u>x</u>	Geology of Treatment Zone	;.		_	_	•				
				-	_	•			dated sediments s of lower perme	
			<u>X</u>						•	meability material
						red bedrock (meability material
						limestone, sar		amino rook)	
<u>x</u>	Treatment Targe Zone:	:	Saturated	d only			<u>x</u>	Both (Sat	urated and Vados	e zones)
<u>x</u>	Start of Thermal Test:	10/21/2		,		-	on: 32 n			,
<u>x</u>	Hydraulic Control		Yes	No		24.4	o <u>521</u>	<u>iomis</u>		
_	,	_		<u> </u>						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				595000			Un	known (_ x ft)
	Thickness of target zone (ft):			<u>10</u>			Un	known	
	Depth to top of target zone	(ft bgs)	:		<u>6</u>			Un	known	
	Thickness of target zone be	elow wa	ater table	(ft):	<u>6</u>				known	
	Number of energy delivery	points:			<u>34</u>			Un	known	
	Number of extraction points	S :			<u>70</u>			Un	known	
<u>x</u>	Temperature Profile:									
	Initial formation temperature	e (deg (C):			<u>21</u>			Unknow	n
	Maximum representative for	rmatior	n tempera	ature (deg C):	<u>104</u>			Unknow	n
	Time to reach maximum re	present	ative ten	nperature (da	ays):	<u>20</u>			n	
	Duration of treatment at rep	resenta	ative tem	perature (da	ays):	<u>49</u>			Unknow	n
						<u>1</u>	<u>Date</u>		Temperatu	ure (deg C)
	Formation temperature imn									
	Formation temperature pos			_	t 1:				-	
	Duration of post-treatment	monitor	ing (days	s):						
<u>x</u>	Mass of contaminant remov	/ed:								
	Via I	iquid pu	umping:		27822	23	<u>x</u>	lb	kg	Unknown
	In va	por str	eam:		<u>8660</u>	0	<u>x</u>	lb	kg	Unknown
	Tota	l:			<u>36482</u>	<u>23</u>	<u>X</u>	lb	kg	Unknown
	Comments:									
	Total volu	ıme tre	eated of	56,000vd3						
	Attachments:	and ut	Jaiou Ul	<u>,yu3</u>						

Cost and Performance Facility ID#: 0245

Performan	nce				
Remediation	on Goal:				
	In Groundwater	:			
	<u>x</u> In Soil: <u>Red</u>	uce VOC mass in shallow	subsurface soils the ecological		risks to nearby human an
Was the R	Remediation Goal Achieved:				
	In Groundwater				
	Comment	·			
	<u>x</u> In Soil				
	Comment	:			
		<u>yes</u>			
General co	omments on the thermal app	lication:			
Lessons L	earned				
_					
Energy					
Total Ener			kWhr		kWhr/yd ³
	Total energy applied	to treatment zone:		' <u></u> '	m ³ kWhr/yd ³
	Other energy:	_		kWhr/r	m ³ kWhr/yd ³
	Plea	se note other energy:	-		
Cost					
Total Proje	act Cost:				
Total Floje	Consultant Cost:				
					
	Thermal Vendor Cost	<u> </u>		m³ yd³	
	Energy Cost:			m ³ yd ³	
	Other Cost 1:	·			
	Other Cost 2:				
	Other Cost 3:				
Pleas	se note other cost:	Other Cost 1:			
		Other Cost 2:			
		Other Cost 3:			

General Site Information Facility ID#: 0250 JT <u>x</u> PD ____ File Analyzed By: Date: 10/18/2006 ____Other: Type of treatment: ____ Conductive <u>X</u> Steam ERH ____ Pesticides Type of Contaminant: ___ Chlorinated Solvents Petroleum Hydrocarbons ____ Wood Treating Other: Treatment Status: ____ Active Post $\underline{\mathbf{x}}$ ____ Pilot Test Type of Test: Full Scale System Start of Test: End of Test: Sep-93 Duration: 746 days Sep-91 Type of Site: ____Non-DOD __ DoD Facility Name: Rainbow Disposal Address: City, State, Zip Code: Huntington Beach, CA OU# or Site #: _____ Primary point of contact: Paul de Percin Organization: EPA SITE Address: __ City, State, Zip Code: Phone #: email: Other contacts or vendors who worked on site __ None Nancy Olson Martin ____ Vendor, Consultant _____ Vendor, Technical Applications ____ Other Type: Organization: Address: City, State, Zip Code: email: _____ Phone #: 951-782-4497 QA/QC

_ Characteristics of Interest	
Good pre- and post-treatment groundwater data	Good pre- and post-treatment soil data
Good temperature profile vs. time information	Flux assessment
Groundwater elevations	Geologic cross-section
Hydraulic Conductivity information	

Gene	eral Site Ass	sessment Data					Facility II	D#: <u>0250</u>
<u>x</u>	Impacted 2	Zone: Length (parallel to flo	w direction)(ft.): <u>below</u>	Width (ft):	Thick	kness (ft):		Unknown
		Impacted zone	as defined by documentation	1				
		Alternative meth	nod for determining size of im	npacted zone (See source zo	ne definition attachmer	nts)		
		Map attachmen	t					
<u>x</u>	Monitor W	/ells: Number of relevant r	monitoring wells with ground	water data:				x None
				Pre-treatment:		Post-treatment:		
		Number of wells rela	tive to treatment zone:					
		Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
<u>x</u>	Soil Boring	s: Number of relevant se	oil borings with pre-treatment	t data: <u>12</u>				
		Number of relevant so	oil borings with post-treatmer	nt data: <u>24</u>				
		Number inside treatm	nent zone: 12 / 18	Number outside	treatment zone:	0/6		
<u>x</u>	Types of C	ontaminants		-				
						ent Concentration per nical:		ent Concentration per nical:
		Chlorinated Solvents:	Petroleum Hydrocarbons:	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel	x <u>TPH</u>	None	5,000 mg/kg	None	5,000 mg/kg
		1,1-dichloroethene	Napthalene	x TRPH	None	None	None	1,000 mg/kg
		cis-1,2-dichloroethene	x Benzene		None	None	None	None
		trans-1,2-dichloroethene	x Tolune		None	None	None	None
		1,1-dichloroethane	<u>x</u> Ethylbenzene		None	None	None	None
		1,2-dichloroethane	x m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	x o-xylene		None	None	None	None
	emicals of Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
	Comme	nts:		70,000 to 135,000	gallons of diesel spil	lled_	Impacted are	ea of 2.3 acres
	Attachman	-	concentration -	3670 mg/kg post - 3190 m	ig/kg TRPH posi	t concentration 2083		TPH pre
	Attachmen							
		-						

Нус	drogeologic Conceptua	al Model		Facility ID#: 0250
<u>x</u>	Geology:	Zone	Unconsolidated Sediments	
_		Vadose Zone:	Relatively homogeneous and permeable unconsolidat	ed sediments
			Relatively homogeneous and impermeable unconsolic	
			<u>x</u> Largely permeable sediments with inter-bedded lense	
			Largely impermeable sediments with inter-bedded lay	
			Competent, but fractured bedrock (i.e. crystalline rock	
			Weathered bedrock, limestone, sandstone	
		Saturated Zone:	Relatively homogeneous and permeable unconsolidat	ed sediments
		Gataratea Eerre.	Relatively homogeneous and impermeable unconsolic	
			x Largely permeable sediments with inter-bedded lense	
			Largely impermeable sediments with inter-bedded lay	
			Competent, but fractured bedrock (i.e. crystalline rock	
			Weathered bedrock, limestone, sandstone	
			Weathered bedrock, innestone, sandstone	
<u>x</u>	Ground surface ele	vation based on wells	in or adjacent to treatment zone: ft amsl	<u>x</u> Unknown
<u>x</u>	Aquifer Characteris	tics:		
	Is more than 1 aqui	fer present?	NoYes (number): <u>x</u>	Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer	3
	Depth to water:	low value (ft bgs):	<u></u>	
		high value (ft bgs):	<u>40</u>	
		Unknown:		
	_ Flow direction			
<u>x</u>	Horizontal hydraulio	gradient (feet/foot):		<u>x</u> Unknown
	Vertical hydraulic gr	-		<u>x</u> Unknown
	, ,	, ,		
x	K range (ft/day)	Measur	ed using: Slug Test Laboratory	Field data
_	,,	low		<u>x</u> Unknown
		high		
	Transmissivity (ft2/c	•	ed using: Slug Test Laboratory	Field data
	- '	low		<u>x</u> Unknown

high

Comments:

Attachments:

The	ermal Treatment - Design							Fa	acility ID#:	<u>0250</u>
<u>x</u>	Thermal treatment:		Conduct	ive						
			Electrica	l Resistance						
			_	3 phase		_ 6 phase		AC power	DC	power
		<u>x</u>	Steam							
				Steam		Steam + air		Steam + O2		
			Other (de	escribe)						
<u>x</u>	Type of Test:	_ Pilo	ot test	<u>x</u> Full-	scale System	1				
<u>x</u>	Geology of Treatment Zon	e:		Relatively	homogeneo	ous and permeal	ble unco	nsolidated se	diments	
				Relatively	homogeneo	ous and imperme	eable un	consolidated	sediments	
			<u>x</u>	Largely pe	ermeable se	diments with inte	er-bedde	ed lenses of lo	ower permeal	cility material
				Largely im	npermeable	sediments with	inter-bed	lded layers of	higher perm	eability material
				Competer	nt, but fractu	ıred bedrock (i.e	. crystall	ine rock)		
				Weathere	d bedrock,	imestone, sands	stone			
<u>x</u>	Treatment Targe Zone:		Saturate	ed only	Vado	ose only	<u>x</u> 1	Both (Saturate	d and Vadose	zones)
<u>x</u>	Start of Thermal Test:	Sep	<u>-91</u>			Duration:	746 da	<u>ys</u>		
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No						
	Treatment Call Design.									
<u>x</u>	Treatment Cell Design:				100100			I Indonesia	n (<u>42</u>	5 x 225 ft)
	Size of target zone (ft2):	41.			100188		-	Unknow	,	<u>5</u> x <u>225</u> ft)
	Thickness of target zone (f		~~\·		<u>25</u>		•	Unknow		
	Depth to top of target zone	`	o ,	· /f4).	<u>10</u>		-	Unknow		
	Thickness of target zone b			e (IL):	<u>15</u>		-	Unknow		
	Number of energy delivery points: Number of extraction points:			<u>35</u>		•	Unknow			
	Number of extraction point	S.			<u>38</u>		-	Unknow	n	
<u>x</u>	Temperature Profile:									
	Initial formation temperatu	re (de	eg C):			<u>18</u>		_	Unknown	
	Maximum representative for	ormat	ion tempe	ature (deg C)):	<u>66</u>		_	Unknown	
	Time to reach maximum re	epres	entative te	mperature (da	ays):	380			Unknown	
	Duration of treatment at re	prese	entative ten	nperature (da	ys):	<u>366</u>		_	Unknown	
						<u>Dat</u>	<u>te</u>		Temperatur	e (deg C)
	Formation temperature im-	media	ately post-t	reatment:						
	Formation temperature po	st-tre	atment mo	nitoring event	t 1:					
	Duration of post-treatment	mon	itoring (day	/s):						
<u>x</u>	Mass of contaminant remo	ved:								
_			d pumping:		700 g	al	1	lh	kg	Unknowr
		•	stream:		15400	_			kg	Unknowr
	Tota	-	o oa		16000	-			kg	Unknown
	Comments									
	Comments:									
	Spacing	- 45	ft with wel	ls of opposite	e type and	60 ft for wells of	f same t	<u>ype</u>		
	Attachments:				-					

Cos	st and Performanc	е				Facility ID#:	0250
<u>x</u>	Performance						
	Remediation Go	oal:					
		In Groundwater:					
		x In Soil:					
			See if Technology could ac	chieve the RWQC	B requirement	for soil = 1000	mg/kg TPH
	Was the Remed	liation Goal Achieved:					
		In Groundwater	_				
		Comment:					
		x In Soil					
		Comment:					
			No requirements were not me	<u>et</u>			
	General comme	ents on the thermal appli	cation:				
	Cost - \$46	s/yd3_					
	Cost shee	for complete details					See
	Lessons Learne	ed					
	_						
	_ Energy				3		3
	Total Energy Us		-	kWhr	kWhr/m ³		
		Total energy applied to	treatment zone:			_ kWhr/m ³	
		Other energy:				_ kWhr/m ³	kWhr/yd ³
		Pleas	e note other energy:				
<u>x</u>	Cost						
_	Total Project Co	ost:	4401120				
	,	Consultant Cost:					
		Thermal Vendor Cost:					
	<u>x</u>	Energy Cost:	- <u>631470</u>	r	m ³	_yd³	
	<u>~</u>	Other Cost 1:		'	··	- ,~	
		Other Cost 1:					
		Other Cost 3:					
		_	Other Cost 1:				
	Please no	te other cost:	Other Cost 1:				
			Other Cost 2:		_		

____ Other Cost 3:

Source:

Environmental Protection Agency, In situ steam enhanced recovery process Hughes Environmental Systems, Inc., Innovative Technology Evaluation Report, EPA/540/R-94/510, National Risk Management Research Laboratory, Cincinnati, OH, July 1995b.

^{**}For each cost category, costs per cubic yard are reported to the nearest cent.

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/29/2006
	Type of treatment:	Conductive		_ Steam	ERH	<u>x</u>	Other:	Hot air	
	Type of Contaminant:	Chlorinated Sol	vents	<u>x</u>	Petroleum Hy	drocarb	ons	Pesticide	s
		Wood Treating			_Other: _				
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	Pilot Test	<u>x</u>	Full Scale	e System				
	Start of Test:	<u>1991</u>		End	of Test: <u>1993</u>			Duration: < 1	0 months
	Type of Site:	<u>x</u> Non-DOD		_DoD					
<u>x</u>	Facility Name: <u>Service Sta</u>	ation							
	Address:								
	City, State, Zip Code:	San Francisco, CA							
	OU# or Site #:								
<u>x</u>	Primary point of contact:	Robert Dahl							
	Organization: <u>TerraVac</u>								
	Address:								
	City, State, Zip Code:								
	Phone #: 925-363-7322			email: rdal	nl@terravac.com				
<u>x</u>	Other contacts or vendors wh	no worked on site			None				
	Point of contact: <u>Terr</u>	aVac Website							
	Type:Vendor, C	onsultant	Ven	dor, Techni	cal Applications	3	Otl	her	
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:		_	email:					
Q.	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	atment groundwater dat	a		Good p	re- and p	ost-treatme	ent soil data	
	Good temperature prof	file vs. time information			Flux as	sessmen	t		
	Groundwater elevation	ıs			Geolog	ic cross-	section		
	Hydraulic Conductivit	y information							

0260

General Site Information

General Site As	ssessment Data					Facility II	D#: <u>0260</u>
Impacted	Impacted zone a				ness (ft):	_	Unknown
Monitor \	Map attachment Nells: Number of relevant m	nonitoring wells with groundy	vater data:				None
			Pre-treatment:		Post-treatment:		
	Number of wells relat	ive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	t data:				
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
x Types of 0	Contaminants		1				
				Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Observiced as 4	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane	x super unleaded gasoline		None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
Attachme	nts:						

Hydrogeologic Conceptual Model Facility ID#: 0260 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _____ft amsl _ Unknown _ Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: _ Flow direction Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: __ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory _ Field data low ____ Unknown high Comments:

Attachments:

The	rmal Treatment - Design						Facility ID#:	0260
<u>x</u>	Thermal treatment:	Condu	ctive					
		Electri	cal Resistance					
			3 phase	6	phase	AC pow	/er D	C power
		Steam			-			
			Steam	St	eam + air	Steam +	- O2	
		<u>x</u> Other	(describe)	Hot air				
<u>x</u>	Type of Test:	Pilot test	· -	scale System				
<u>x</u>	Geology of Treatment Zone	e:					ated sediments	
			-	-	•		lidated sediments	
							es of lower perme	-
								meability material
						crystalline roc	:k)	
				d bedrock, lime				
	_ Treatment Targe Zone:	Satur	ated only	Vadose	,		aturated and Vados	e zones)
<u>X</u>	Start of Thermal Test:	<u>1991</u>			Duration:	2 years		
	_ Hydraulic Control	Yes	No					
	T ((0 D)							
	_ Treatment Cell Design:							
	Size of target zone (ft2):					·	nknown (x ft)
	Thickness of target zone (f					·	nknown	
	Depth to top of target zone		I-1- (ft)				nknown	
	Thickness of target zone be		DIE (π):				nknown	
	Number of energy delivery	-					nknown	
	Number of extraction points	5:		-		0	nknown	
	_Temperature Profile:							
	Initial formation temperatur	e (dea C):					Unknow	n
	Maximum representative for		perature (ded C)·			Unknow	
	Time to reach maximum re						Unknow	
	Duration of treatment at rep						Unknow	
	Duration of treatment at rep	Dieseritative	temperature (ua				Clikilow	п
					Date	۵	Temperati	ure (deg C)
	Formation temperature imr	nediately pos	t-treatment		<u>Dan</u>	<u>~</u>	Tomporus	<u>aro (dog 0)</u>
	Formation temperature pos	-		+ 1·				
	Duration of post-treatment		•				-	
			,-	_				
<u>x</u>	Mass of contaminant remove	ved:						
_	Via I	iquid pumpin	g:			lb	kg	Unknown
	In va	apor stream:				lb	kg	Unknown
	Tota	d:		80000		<u>x</u> lb	kg	Unknown
							- 5	
	Comments:							
	Attachments:							

Cost and Performance					Facility ID#:	0260
Performance						
Remediation Goal:						
	- In Groundwater: -					
	0.00					
	 In Soil:					
_						
Was the Remediation	on Goal Achieved:					
	In Groundwater					
	Comment: -					
	-					
	_ In Soil					
	Comment: -					
	_					
Consession	on the the server ! "	ation.				
General comments	on the thermal applica	ation:				
Hot air increas	ed extraction rated by	y up to a factor of three	over those withou	ut hot air injection.		
Lessons Learned						
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	kW	/hr/yd ³
	tal energy applied to t	treatment zone:	<u> </u>		kWhr/m ³	-
					_	
Oti	ner energy:	_			_ kWhr/m ³	kWhr/yd
	Please	note other energy:				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
The	ermal Vendor Cost:					
En	ergy Cost:			m³	_ yd ³	
	ner Cost 1:					
· 	ner Cost 2:	_				
· 						
· 	ner Cost 3:					
Please note of	ther cost:	Other Cost 1:				
	_	0.1101 0001 1:				
	_	Other Cost 2:				

File Analyzed By: ____ PD ____ Date: 9/26/2006 ____Other: Type of treatment: ____ Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: _Active Post Type of Test: Pilot Test Full Scale System Start of Test: 8/17/1988 End of Test: 9/12/1988 Duration: 15 Type of Site: Non-DOD __ DoD Facility Name: Solvent Services Address: 1021 Berryessa Rd City, State, Zip Code: San Jose, CA OU# or Site #: Primary point of contact: Organization: Address: City, State, Zip Code: email: ____ Phone #: Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC Characteristics of Interest ___ Good pre- and post-treatment groundwater data _ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information Flux assessment ___ Groundwater elevations Geologic cross-section

Facility ID#:

0270

General Site Information

___ Hydraulic Conductivity information

<u>x</u> Impacted	Zone: Len	Impacted zone a	w direction)(ft.): <u>below</u> as defined by documentation and for determining size of im		<u></u>	ness (ft):	<u> </u>	Unknown
		_ Map attachment		,		,		
<u>x</u> Monitor V	Vells: Nu	mber of relevant m	nonitoring wells with grounds	vater data:				x None
				Pre-treatment	t	Post-treatment:		
	Nu	mber of wells relat	tive to treatment zone:					
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
x Soil Boring	gs: Nun	nber of relevant so	oil borings with pre-treatment	: data: <u>6</u>				
	-		oil borings with post-treatmer					
		nber inside treatme	= "		de treatment zone:			
x Types of 0	Contaminants							
					Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:
	Chlorina	ted Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroe	thene	Hexane	Creosote	None	100 mg/kg	None	50 mg/kg
	x Tetrachlor	oethene	Jet Fuel		None	100 mg/kg	None	10 mg/kg
	x 1,1-dichlor	roethene	Napthalene		None	0.5 mg/kg	None	10 mg/kg
	cis-1,2-dic	hloroethene	x Benzene		None	0.05 mg/kg	None	None
	trans-1,2-d	lichloroethene	x Tolune		None	50 mg/kg	None	50 mg/kg
	1,1-dichlor	roethane	<u>x</u> Ethylbenzene		None	100 mg/kg	None	50 mg/kg
	1,2-dichlor	roethane	m/p-xylene	x 2-butanone	None	50 mg/kg	None	100 mg/kg
Chemicals of	<u>x</u> 1,1,1-trich	loroethane	o-xylene		None	100 mg/kg	None	50 mg/kg
Concern	1,1,2-trich	loroethane	x 1,2-dichlorobenzene		None	100 mg/kg	None	None
	1,1,2,2-tetr	rachloroethane	x aceton		None	500 mg/kg	None	500 mg/kg
	Vinyl Chlo	oride	x total xylenes		None	500 mg/kg	None	100 mg/kg
	x <u>11-dca</u>				None	0.1 mg/kg	None	None
	x MeCl2				None	10 mg/kg	None	None
			x <u>trichlorofluorethene</u>		None	50 mg/kg	None	50 mg/kg
	x cis-1,2-dic	hloroethene			None	0.5 mg/kg	None	None
			x 4-methyl-2-pentanone		None	1 mg/kg	None	10 mg/kg
			x 2-hexanone		None	0.5 mg/kg	None	None
Comme	ents:							
				41 000 vd3 contam	inated at greater than	0.010		
	ppm			•	2		Concentrations from	Table 1 for pre and
				Appendix C hol	les A1 and A2 average	<u>s</u>		
Attachmer	nts:							
							<u> </u>	

0270

General Site Assessment Data

Hydrogeologic Conceptual Model

X Geology: Zone Unconsolidated Sediments
Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments
Relatively homogeneous and impermeable unconsolidated sediments
Relatively homogeneous and impermeable unconsolidated sediments
Largely permeable sediments with inter-bedded lenses of lower permeability material
X Largely impermeable sediments with inter-bedded layers of higher permeability material
Competent, but fractured bedrock (i.e. crystalline rock)

			Re	elatively	homoge	eneous and	d imperme	able unconsolidate	d sediments		
			La	rgely pe	ermeable	e sediment	s with inte	r-bedded lenses of	lower permeabi	lity material	
			<u>x</u> La	rgely in	npermea	ble sedime	ents with in	ter-bedded layers	of higher perme	ability material	
			Competent, but fractured bedrock (i.e. crystalline rock)								
			W	eathere	d bedroo	ck, limesto	ne, sandst	one			
		Saturated Zone:	Re	elatively	homoge	eneous and	d permeab	le unconsolidated :	sediments		
			Re	elatively	homoge	eneous and	d imperme	able unconsolidate	d sediments		
			<u>x</u> La	rgely pe	ermeable	e sediment	s with inte	r-bedded lenses of	lower permeabi	lity material	
			La	rgely in	npermea	ble sedime	ents with in	ter-bedded layers	of higher perme	ability material	
			Co	mpeter	nt, but fra	actured be	drock (i.e.	crystalline rock)			
			w	eathere	d bedroo	ck, limesto	ne, sandst	one			
<u>x</u>	Ground surface elev	ation based on wells in	or adjacer	nt to trea	atment z	one:	75 to 100	ft amsl		Unknown	
<u>x</u>	Aquifer Characteristi	cs:									
	Is more than 1 aquife	er present?	_ No	<u>x</u>	Yes (number):			Unknown (assum	e single aquifer)	
			Aqu	ifer 1		Aqui	fer 2	Aquifer 3			
	Depth to water:	low value (ft bgs):	<u>0</u>		_						
		high value (ft bgs):							_		
		Unknown:									
<u>x</u>	Flow direction		$\underline{\mathbf{W}}$		-						
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):							<u>x</u>	Unknown	
	Vertical hydraulic gra	adient (feet/foot):							<u>x</u>	Unknown	
<u>x</u>	K range (ft/day)	Measured	d using:		_ Slug T	est	Labo	oratory	Field data		
		low							<u>x</u>	Unknown	
		high									
	Transmissivity (ft2/da	ay): Measured	d using:		_ Slug T	est	Labo	oratory	Field data		
		low							<u>x</u>	Unknown	
		high									
	Comments:										
	Tra	ansmissivity = 200 gal	per day i	oer foot	t; Sto	rativitv - 0	.22 bo	oth for aquifer			
	<u>A</u>				, 210			om Figure 3 cont	<u>ours</u>		
	Attachments:										

The	rmal Treatment - Design							Facility ID	027	<u>′0</u>
<u>x</u>	Thermal treatment:		_ Conductiv	е						
			_ Electrical	Resistance						
		<u>x</u>	Steam	_ 3 phase		_ 6 phase	AC pov	wer	_DC power	r
		-	X Other (des	Steam		_ Steam + air	Steam	+ O2		
<u>x</u>	Type of Test: <u>x</u>	Pilot			-scale System	n				
<u>x</u>	Geology of Treatment Zone				•	ous and permeal	hle unconsolid	lated sediment	S	
^	Coology of Frodundin Zone	J.		_	_	ous and imperme				
			<u>x</u>	-	_	ediments with inte				material
						sediments with i		-	-	
						ured bedrock (i.e				•
						limestone, sands				
<u>x</u>	Treatment Targe Zone:	<u>x</u>	Saturated	donly	Vad	ose only	Both (S	Saturated and Va	dose zones)
<u>x</u>	Start of Thermal Test:	8/17	/1988			Duration:	15 days			
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>169</u>		t	Jnknown	(<u>13</u> x	<u>13</u> ft)
	Thickness of target zone (f	t):			<u>18</u>		^U	Jnknown		
	Depth to top of target zone		•		2		<u> </u>	Jnknown		
	Thickness of target zone be			(ft):	<u>20</u>		<u> </u>	Jnknown		
	Number of energy delivery		S:		<u>6</u>			Jnknown		
	Number of extraction points	S:			1		(Jnknown		
<u>x</u>	Temperature Profile:									
_	Initial formation temperatur	e (de	g C):			<u>26</u>		Unk	nown	
	Maximum representative for			ature (deg C	:):	100		Unk	nown	
	Time to reach maximum re	prese	ntative ten	perature (d	ays):	<u>1</u>		Unk	nown	
	Duration of treatment at rep	oresei	ntative tem	perature (da	ays):	<u>>1</u>		Unk	nown	
						<u>Dat</u>	<u>e</u>	Tempe	erature (de	<u>g C)</u>
	Formation temperature imm				4 4 .					
	Formation temperature pos Duration of post-treatment			-	ι ι.					 -
	Duration of poor troutmont		omig (day	,,.						
<u>x</u>	Mass of contaminant remove	ved:								
	Via I	iquid	pumping:		<u>186.</u>	8	lb	<u>x</u> kg	_	Unknow
	In va	apor s	tream:		<u>548.</u>	<u>3</u>	lb	<u>x</u> kg		Unknow
	Tota	ıl:			<u>762.</u>	<u>7</u>	lb	<u>x</u> kg	_	Unknow
	Comments:									
	Comments.									
	Attachments:									

t and Performance			Facility ID#:	0270
_ Performance				
Remediation Goal:				
In Groundy	vater:			
	<u> </u>			
In Soil:				
Was the Remediation Goal Achiev	rod:			
Comr	ment:			
In Soil				
Comr	•			
General comments on the therma	application:			
_ Energy				
Total Energy Used:		kWhr kWhr/m	³ kW	/hr/yd³
Total energy app	lied to treatment zone:		kWhr/m ³	kWhr/
Other energy:	_		kWhr/m³	kWhr
	Please note other energy:			
_ Cost				
Total Project Cost:				
•				
Consultant Cost:				
				
Consultant Cost: Thermal Vendor Energy Cost:		 m³	yd ³	
Thermal Vendor Energy Cost:		m³	yd³	
Thermal Vendor Energy Cost: Other Cost 1:		m³	yd³	
Thermal Vendor Energy Cost: Other Cost 1: Other Cost 2:		m³	yd³	
Thermal Vendor Energy Cost: Other Cost 1: Other Cost 2: Other Cost 3:	Cost:	m³	yd³	
Thermal Vendor Energy Cost: Other Cost 1: Other Cost 2:	Cost: Other Cost 1:	m³	yd³	
Thermal Vendor Energy Cost: Other Cost 1: Other Cost 2: Other Cost 3:	Cost:	m³	yd³	

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/29/2006
	Type of treatment:	Conductive		_ Steam	ERH	<u>x</u>	Other:	Hot air	
	Type of Contaminant:	Chlorinated Solv		_ <u>x</u>	Petroleum Hyo			Pesticides	
	7,62 2	Wood Treating		_	Other:				
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	Pilot Test	<u>x</u>	Full Scale	System				
	Start of Test:			End	of Test:			Duration:	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: McClellan Address:	AFB Superfund Site							_
	City, State, Zip Code: OU# or Site #:	Sacramento, CA							_
<u>x</u>	Primary point of contact: Organization: TerraVac Address: City, State, Zip Code:	Robert Dahl							
	Phone #: 925-363-7322			email: rdal	nl@terravac.com				
<u>x</u>	Other contacts or vendors wh				None				
	·	aVac Website							
		onsultant					Oth		
	-								
	City, State, Zip Code:								
	Phone #:			email:					
^	A/QC								
W.	A/QC								
	_Characteristics of Interest								
	Good pre- and post-trea	atment groundwater data	ı		Good pr	e- and p	ost-treatme	nt soil data	
	Good temperature prof	file vs. time information			Flux ass	essment			
	Groundwater elevation	ıs			Geologic	cross-s	section		

0275

General Site Information

_____ Hydraulic Conductivity information

General Site As	sessment Data					Facility II	D#: <u>0275</u>
Impacted	5 ".	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
	 -	nod for determining size of im		ne definition attachmen	ts)		
	Map attachment	=	,		,		
Monitor V	Vells: Number of relevant n	nonitoring wells with ground	vater data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	tive to treatment zone:	T TO LIGALITOTIA				
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				3			
Soil Borin	gs: Number of relevant so	oil borings with pre-treatment	data:				
		oil borings with post-treatmer					
	Number inside treatme			treatment zone:			
			_				
Types of (Contaminants						
				Average Pre-treatme Chem	nt Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
Concern	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
	-						
Comme	ents:						
	-						
Attachmer	nts:						
,				·		·	·

Geology: Zone Unconsolidated Sediments Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material	al
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability mate	al
Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material	al
Largely impermeable sediments with inter-bedded layers of higher permeability mate	al
	al
Competent, but fractured bedrock (i.e. crystalline rock)	
Weathered bedrock, limestone, sandstone	
Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments	
Relatively homogeneous and impermeable unconsolidated sediments	
Largely permeable sediments with inter-bedded lenses of lower permeability material	
Largely impermeable sediments with inter-bedded layers of higher permeability mate	al
Competent, but fractured bedrock (i.e. crystalline rock)	
Weathered bedrock, limestone, sandstone	
Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown	
Aquifer Characteristics:	
Is more than 1 aquifer present? No Yes (number): Unknown (assume single aqui	er)
Aquifer 1 Aquifer 2 Aquifer 3	
Depth to water: low value (ft bgs):	
high value (ft bgs):	
Unknown:	
Flow direction	
Horizontal hydraulic gradient (feet/foot): Unknown	
Vertical hydraulic gradient (feet/foot): Unknown	
K range (ft/day) Measured using: Slug Test Laboratory Field data	
low Unknown	
high	
Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data	
low Unknown	
high	
Comments:	
	_
Attachments:	_

Thermal treatment:	Conducti	ive			
Thermal treatment:		<u>-</u>			
	Electrica	l Resistance	6 L	A.C. ======	DC
		3 phase	6 phase	AC power	DC power
	Steam		g, , ,	g	
	_	Steam		Steam + O2	
	X Other (de		t Air		
Type of Test:	Pilot test	x Full-scale	-		
Geology of Treatment Z	one:	_	nogeneous and permeable		
		-	nogeneous and impermea		
		_			ower permeability materia
				•	f higher permeability mate
	_		ut fractured bedrock (i.e. o		
	_		drock, limestone, sandsto		
Treatment Targe Zone:	Saturate	ed only	-		d and Vadose zones)
Start of Thermal Test:	-		Duration:		
Hydraulic Control	Yes	No			
Treatment Cell Design:					
Size of target zone (ft2):		_		Unknow	rn (<u> </u>
Thickness of target zone	e (ft):	_		Unknow	'n
Depth to top of target zo	one (ft bgs):	_		Unknow	'n
Thickness of target zone	e below water table	e (ft):		Unknow	'n
Number of energy delive	ery points:	<u>17</u>		Unknow	'n
Number of extraction po	ints:	_		Unknow	'n
Temperature Profile:					
Initial formation tempera				-	Unknown
Maximum representative	•			-	Unknown
Time to reach maximum	representative te	mperature (days):			Unknown
Duration of treatment at	representative ter	mperature (days):			Unknown
			<u>Date</u>		Temperature (deg C)
Formation temperature i					
Formation temperature		•			
Duration of post-treatme	ent monitoring (day	/s):			
Mass of contaminant ren					
	ia liquid pumping:			lb	kg Unki
	vapor stream:	-			kg Unki
Т	otal:			lb	kg Unki
0					
Comments:					
Attachments:					

Cost and Performance Facility ID#: 0275 Performance Remediation Goal: _ In Groundwater: -__ In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: ___ In Soil Comment: General comments on the thermal application: Lessons Learned Energy __ kWhr/yd³ ____ kWhr/m³ Total Energy Used: ____ kWhr _kWhr/yd³ kWhr/m³ _ Total energy applied to treatment zone: _ kWhr/m³ _ kWhr/yd³ ___ Other energy: Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ___ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1: _ Other Cost 2:

Other Cost 3:

General Site Information Facility ID#: 0280 File Analyzed By: PD ____ Date: 8/28/2006 Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: _Active Post Type of Test: Pilot Test Full Scale System Start of Test: May-97 End of Test: Jul-00 Duration: 37 months Type of Site: Non-DOD _ DoD Facility Name: Visalia Poleyard Address: City, State, Zip Code: CA OU# or Site #: Primary point of contact: Craig Eaker Organization: Souhern California Edison 2344 Walnut Grove Avenue Address: RP&A - EH&S, Quad 3A City, State, Zip Code: Rosemead, CA 91770 Phone #: <u>626-302-8531</u> email: _ Other contacts or vendors who worked on site ____ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment

_ Geologic cross-section

____ Groundwater elevations

x Impacted 2	x Impacted zone a	v direction)(ft.): <u>Below</u> us defined by documentation od for determining size of in		Width (ft):		ness (ft):		_	Unknown
<u>x</u> Monitor V	Vells: Number of relevant m	nonitoring wells with ground	watei	r data: Pre-treatment:		Post-treatment:		<u>x</u>	None
	Number of wells relat	ive to treatment zone:							
	Pre-treatment	In:	U	pgradient:	Downgradient:	Cros	ssgradient:		
	Post-treatment	In:	U	pgradient:	Downgradient:	Cros	ssgradient:		
Soil Boring	s: Number of relevant so	il borings with pre-treatmen	t data	a:					
	Number of relevant so	il borings with post-treatment	nt da	ta:					
	Number inside treatme	ent zone:	_	Number outside	e treatment zone:				
x Types of C	Contaminants	T			T				
					Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Cher	nent Comical:	ncentration per
	Chlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)
	Trichloroethene	Hexane	x	Creosote	None	None	0.001 mg/L		None
	Tetrachloroethene	Jet Fuel	x	<u>PCP</u>	None	None	0.001 mg/L		None
	1,1-dichloroethene	Napthalene	x	Benzo(a)pyrene	None	None	0.5 mg/L		None
	cis-1,2-dichloroethene	Benzene	x	TPH - Diesel	None	None	None		None
	trans-1,2-dichloroethene	Tolune	x	Dioxin	None	None	None		None
	1,1-dichloroethane	Ethylbenzene			None	None	None		None
	1,2-dichloroethane	m/p-xylene			None	None	None		None
	1,1,1-trichloroethane	o-xylene			None	None	None		None
Chemicals of Concern	1,1,2-trichloroethane				None	None	None		None
	1,1,2,2-tetrachloroethane				None	None	None		None
	Vinyl Chloride				None	None	None		None
					None	None	None		None
					None	None	None		None
					None	None	None		None
					None	None	None		None
					None	None	None		None
					None	None	None		None
Comme			<u>N/</u>	·	50 ft; Impacted area		tment data from June	e 2006	S with Dioxins
Attachmen								_	

0280

General Site Assessment Data

Hydı	rogeologic Conceptual	Model					Facility ID	#: <u>0280</u>
<u>x</u>	Geology:	Zone	Unconsoli	dated Sediment	<u>s</u>			
		Vadose Zone:	Rela	tively homogene	ous and permea	ble unconsolidated so	ediments	
			Rela	tively homogene	ous and imperm	eable unconsolidated	sediments	
			<u>x</u> Large	ely permeable s	ediments with int	er-bedded lenses of I	ower permeab	ility material
			Large	ely impermeable	sediments with	inter-bedded layers o	f higher perme	ability material
			Com	petent, but fract	ured bedrock (i.e	. crystalline rock)		
			Wea	thered bedrock,	limestone, sands	stone		
		Saturated Zone:	Rela	tively homogene	ous and permea	ble unconsolidated so	ediments	
			Rela	tively homogene	ous and imperm	eable unconsolidated	sediments	
			<u>x</u> Large	ely permeable s	ediments with int	er-bedded lenses of I	ower permeab	ility material
			Large	ely impermeable	sediments with	inter-bedded layers o	f higher perme	ability material
			Com	petent, but fract	ured bedrock (i.e	e. crystalline rock)		
			Wea	thered bedrock,	limestone, sands	stone		
<u>x</u>	Aquifer Characteristic Is more than 1 aquife Depth to water:		_No Aquife	<u>x</u> Yes (nu r 1	e:	t amsl t t Aquifer 3 t t t t t t t t t t t t t t t t	<u>X</u> Jnknown (assum	Unknown ne single aquifer)
	_ Flow direction						_	
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):					<u>x</u>	Unknown
	Vertical hydraulic gra						<u>x</u>	Unknown
							-	
<u>x</u>	K range (ft/day)	Measured	using:	Slug Tes	tLat	boratory _	Field data	
_		low					<u>x</u>	Unknown
		high					_	
	Transmissivity (ft2/da	· ·	using:	Slug Tes	t Lat	boratory _	Field data	
	,,	low	ū			-	<u></u>	Unknown
		high				-		
							_	

Comments:

Attachments:

The	rmal Treatment - Design	ı				Facility ID#:	0280
<u>x</u>	Thermal treatment:	Conductive					
		Electrical R	esistance				
			3 phase	6 phase	AC p	oower Do	C power
		x Steam	DUS/HPO				
			Steam	Steam + air	Steam	m + O2	
		Other (desc	ribe)				
<u>x</u>	Type of Test:	Pilot test	<u>x</u> Full-scale	-			
<u>x</u>	Geology of Treatment	Zone:	•	ogeneous and perme			
			-	ogeneous and imper			
		<u>X</u>		able sediments with i		•	•
				neable sediments wit			meability material
				t fractured bedrock (i	•	rock)	
v	Treatment Targe Zone	: Saturated		drock, limestone, san Vadose only		(Saturated and Vados	a zanas)
<u>X</u>	Start of Thermal Test:	5/12/1997			<u>x</u> Both n: 37 months	(Saturated and Vados	e zones)
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No	Duratio	11. <u>37 monuis</u>		
^	Tryaradile Control	<u>x</u> 103	110				
<u>x</u>	Treatment Cell Design	ı					
_	Size of target zone (ft2		154	<u>,800</u>		Unknown (_ x ft)
	Thickness of target zon		<u>85</u>			Unknown	
	Depth to top of target z	zone (ft bgs):	<u>20</u>			Unknown	
	Thickness of target zon	ne below water table (ft): <u>70</u>			Unknown	
	Number of energy deli	very points:	<u>14</u>			Unknown	
	Number of extraction p	points:	<u>12</u>			Unknown	
<u>x</u>	Temperature Profile:	. (1 0)					
	Initial formation temper		uro (dog C):	120		X Unknow	
	Maximum representati	•		<u>130</u>		Unknow	
	Time to reach maximul Duration of treatment a	•		-		X UnknowX Unknow	
	Duration of treatment a	at representative temp	erature (days).			<u>z</u> Clikilow	11
				D	ate	Temperati	ure (deg C)
	Formation temperature	e immediately post-trea	atment:				
	Formation temperature	e post-treatment monit	oring event 1:				
	Duration of post-treatm	nent monitoring (days)	:				
<u>x</u>	Mass of contaminant re					_	
		Via liquid pumping:		199,500	<u>x</u> lb	kg	Unknown
		In vapor stream:		239,400	<u>x</u> lb	kg	Unknown
		Total:		1,330,000	<u>x</u> lb	kg	Unknown
	Comments:						
	<u>Phas</u> ft	se I treated - 20 to 95	feet; Phase	e II treated - 20 to 1		emoved - 212,800	lh of in-citu
		ation and 678,300 lb	of free produc	t creosote	iviass f	<u> </u>	טוופ־ווו וט טו
	Attachments:						

Cost and Performance Facility ID#: 0280 Performance Remediation Goal: In Groundwater: PCP - 1 ug/L; TCDD (eqv) - 0.00003 ug/L; B(a)P - 0.2 ug/L In Soil: Was the Remediation Goal Achieved: s In Groundwater Comment: 21 wells meet the criteria for PCP and 22 wells for TCDD and B(a)P - out of 25 wells __ In Soil Comment: General comments on the thermal application: \$57/cubic yard actually, but with lessons learned it would have been \$38/cubic yard Lessons Learned Energy ____ kWhr/m³ _ kWhr/yd³ Total Energy Used: ____ kWhr kWhr/yd³ _ Total energy applied to treatment zone: kWhr/m³ ___ Other energy: kWhr/m³ _ kWhr/yd³ Please note other energy: Cost Total Project Cost: 21,500,000 ____ Consultant Cost: ___ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3:

Other Cost 1:
Other Cost 2:
Other Cost 3:

Please note other cost:

Facility ID#: 0290 File Analyzed By: PD ____ Date: 10/6/2006 Type of treatment: Conductive ___ Steam <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: 3/29/2002 End of Test: 1/31/2003 Duration: 309 d Type of Site: Non-DOD __ DoD Facility Name: Lowry Landfill Address: City, State, Zip Code: Denver, CO OU# or Site #: South Waste Pit Primary point of contact: Bonnie Lavelle Organization: Address: City, State, Zip Code: Phone #: 303-312-6579 email: ___ Other contacts or vendors who worked on site _ None Point of contact: Bill Plaehn Type: Vendor, Consultant ___ Vendor, Technical Applications __ Other Organization: Parsons Address: City, State, Zip Code: Phone #: 303-764-8729 email: bill.a.plaehn@parsons.com QA/QC Characteristics of Interest Good pre- and post-treatment groundwater data __ Good pre- and post-treatment soil data __Good temperature profile vs. time information __ Flux assessment Groundwater elevations _Geologic cross-section

General Site Information

General Site As	sessment	Data							Facility ID)#:	0290
<u>x</u> Impacted	Zone:	Impacted zone	ow direction)(ft.): as defined by documentation thod for determining size of im		Width (ft):		kness (ft):		;	<u>x</u>	Unknown
<u>x</u> Monitor V	Vells:	x Map attachmer Number of relevant	nt monitoring wells with grounds	wate	r data:						None
					Pre-treatment:	<u>17</u>	Post-treatment:	<u>5</u>			
		Number of wells rela	ative to treatment zone:								
		Pre-treatment	In: <u>7</u>	ι	pgradient: 3	Downgradient:	<u>1</u> Cro	ssgradient:	<u>6</u>		
		Post-treatmen	t In: <u>0</u>	L	Jpgradient: 2	Downgradient:	<u>1</u> Cro	ssgradient:	<u>2</u>		
x Soil Boring	gs:	Number of relevant s	soil borings with pre-treatment	data	a: <u>14</u>						
		Number of relevant s	soil borings with post-treatmer	nt da	ta: <u>14</u>						
		Number inside treatm	ment zone: 14		Number outside	e treatment zone:	<u>0</u>				
x Types of 0	Contamina	nts									
							ent Concentration per mical:	Average 1	Post-treatme Chem		oncentration per
1	Cł	nlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwat	er (mg/L)		Soil (mg/kg)
	x Tric	hloroethene	Hexane		Creosote	None	None	None			None
	Tetr	rachloroethene	Jet Fuel	x	Methylene Chloride	None	None	None			None
	1,1-	dichloroethene	Napthalene	<u>x</u>	Acetone	None	None	None			None
	cis-	1,2-dichloroethene	x Benzene			None	None	None			None
	tran	s-1,2-dichloroethene	x Tolune			None	None	None			None
	1,1-	dichloroethane	<u>x</u> Ethylbenzene			None	None	None			None
	1,2-	dichloroethane	m/p-xylene	<u>x</u>	2-butanone	None	None	None			None
Chemicals of	<u>x</u> 1,1,	1-trichloroethane	o-xylene			None	None	None	_		None
Concern	1,1,	2-trichloroethane	x Xylenes (perimeter)			10 mg/L	None	5 mg/L			None
	1,1,	2,2-tetrachloroethane	X Xylenes (in treat zone)			10,000 mg/L	500 mg/kg	None		5	00 mg/kg
	Vin	yl Chloride				None	None	None			None
	x Tota	al VOCs (perimeter)				1,000 mg/L	None	100 mg/I	_		None
	x Tota	al VOCs (in treat.zone)			112-0101010-	10,000 mg/L	1,000 mg/kg	None		1,0	000 mg/kg
				x	122trifluroethane	None	None	None			None
						None	None	None			None
						None	None	None			None
						None	None	None			None
Comme	nts:										
	_										
		·		_	· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·				

Attachments:

See attached sheets for concentration data.

Hydı	ogeologic Conceptual I	Model		Facility ID#: 0290
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of lov X Largely impermeable sediments with inter-bedded layers of the Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of lov X Largely impermeable sediments with inter-bedded layers of the Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ediments wer permeability material nigher permeability material liments ediments wer permeability material
<u>x</u>	Ground surface elevat	tion based on wells in o	adjacent to treatment zone: 5760 ft amsl	Unknown
<u>x</u>	Aquifer Characteristic: Is more than 1 aquifer Depth to water:		No Yes (number): <u>x</u> Un Aquifer 1 Aquifer 2 Aquifer 3 12 26	known (assume single aquifer)
<u>x</u>	Flow direction		<u>NW</u>	
X	Horizontal hydraulic g Vertical hydraulic grac	,	0.04 to 0.05	Unknown <u>x</u> Unknown
X	K range (ft/day) Transmissivity (ft2/day)	Measured low high Measured low high		Field dataX UnknownField dataX Unknown

Horizonation hydraulic gradient during treatment was 0.05 to 0.06 ft/ft

Comments:

Attachments:

Ther	rmal Treatment - Design								Fac	ility ID#:	0290	
<u>x</u>	Thermal treatment:		Conductiv	/e								
		<u>x</u>	Electrical	Resistance	-							
				_ 3 phase		_ 6 phase		_AC power		DC	power	
			Steam	G:		G		G				
			Other (des	Steam		_ Steam + air		_ Steam + O2	2			
<u>x</u>	Type of Test: <u>x</u>	Pilot	-	Full-	scale Syste	m						
<u>x</u>	Geology of Treatment Zone			· <u></u>	-	 eous and permeal	ble un	consolidate	d sec	liments		
_	. ,					eous and imperme						
				_ Largely pe	ermeable s	sediments with inte	er-bed	ded lenses	of lov	wer permea	ability m	naterial
			<u>x</u>	Largely im	npermeable	e sediments with i	nter-b	edded layer	s of	higher pern	neabilit	y material
				_ Competer	nt, but frac	tured bedrock (i.e.	crysta	alline rock)				
			_	_ Weathere	d bedrock,	limestone, sands	tone					
<u>x</u>	Treatment Targe Zone:		Saturated	d only	Vac	lose only	<u>x</u>	Both (Satur	rated	and Vadose	zones)	
<u>x</u>	Start of Thermal Test:	3/29/	2002			Duration:	309	<u>day</u>				
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No								
<u>x</u>	Treatment Cell Design:											
	Size of target zone (ft2):				33600			Unkr	nown	(<u>21</u>	<u>0</u> x	<u>160</u> ft)
	Thickness of target zone (ft)):			<u>16</u>			Unkr	nown			
	Depth to top of target zone	(ft bg	s):		<u>10</u>			Unkr	nown			
	Thickness of target zone be	low w	vater table	(ft):	<u>6</u>			Unkr	nown			
	Number of energy delivery	points	S :		<u>220</u>			Unkr	nown			
	Number of extraction points	: :			7			Unkr	nown			
<u>x</u>	Temperature Profile:											
	Initial formation temperature	e (deg	g C):			<u>16</u>				_ Unknown		
	Maximum representative for	rmatio	on tempera	ature (deg C):	<u>84</u>				_ Unknown		
	Time to reach maximum rep	oresei	ntative ten	nperature (da	ays):	<u>211</u>				_ Unknown		
	Duration of treatment at rep	reser	ntative tem	perature (da	ıys):	<u>98</u>				_ Unknown		
						<u>Date</u>	<u>e</u>		-	Temperatui	e (deg	<u>C)</u>
	Formation temperature imm	nediat	ely post-tr	eatment:		1/31/2003			86			
	Formation temperature post	t-treat	tment mor	itoring event	t 1:	4/25/2003			<u>70</u>			
	Duration of post-treatment r	monito	oring (days	s):		Atleast 3 months						
<u>x</u>	Mass of contaminant remov	/ed:										
_	Via li	iquid p	oumping:		<u>75</u>	<u>1</u>		_ lb	<u>x</u>	kg		Unknown
	In va	por st	tream:		<u>163</u>	<u>75</u>		_lb	<u>x</u>	kg		Unknown
	Total	l:			<u>171</u>	<u>27</u>		_ lb	<u>x</u>	kg		Unknown
	Comments:											
	Attachments:											

Cost and Performance	Facility ID#: 0290
Performance	
Remediation Goal:	
In Groundwater:	
	
In Soil:	

Was the Remediation Goal Achieved:	
In Groundwater	
Comment: -	
-	
In Soil	
Comment: -	
-	
General comments on the thermal applic	eation:
General comments on the thermal applic	auui.
	E of all chlorinated and non-chlorianted VOCs 2) Continuous and complete processing of
VOC-laden off-gas during spikes in heating	n concentration s that can occur during
De sules electrode	40 6-14 but in any about the day of the last the last the day of the last the
Regular electrode :	spacing was 18 feet, but in areas where new electrodes were installed the spacing went to 9 ft
causes short-circuiting isuues	al of 90C in some areas because of the metal debris. 2) Metal debris in high densities 3) Difficult ot heat a thin thermal barrier/hot floor just below the waste pits because of the e spacing can off-set the effect of layered highly conductive materials
<u>x</u> Energy	
Total Energy Used: 24758	98 x kWhrkWhr/m ³ kWhr/yd ³
Total energy applied to	-
Other energy:	kWhr/yd³
	e note other energy:
r icast	Filote office energy.
Cost	
Total Project Cost:	
Total Project Cost: Consultant Cost:	
Consultant Cost:	
Consultant Cost: Thermal Vendor Cost:	
Consultant Cost: Thermal Vendor Cost: Energy Cost:	m³yd³
Consultant Cost: Thermal Vendor Cost: Energy Cost: Other Cost 1: Other Cost 2:	m ³ yd ³
Consultant Cost: Thermal Vendor Cost: Energy Cost: Other Cost 1: Other Cost 2: Other Cost 3:	
Consultant Cost: Thermal Vendor Cost: Energy Cost: Other Cost 1: Other Cost 2:	m³ yd³ Other Cost 1:

	=::									
<u>X</u>	File Analyzed By: JT	<u>x</u> PD							Date:	10/30/2006
	Type of treatment:	Conductive		_Steam	ER		<u>X</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	Chlorinated Solv	ents		Petroleur				Pesticides	
	_	Wood Treating		<u>x</u>	Other:	orga	nochl	oropesticide		
	Treatment Status:	Active	<u>X</u>	Post						
	Type of Test:	<u>x</u> Pilot Test	_	Full Scale	e System					
	Start of Test:	<u>1992</u>		End	of Test: 199	<u>92</u>			Duration: 1 m	onth _
	Type of Site:	Non-DOD	<u>X</u>	DoD						
<u>x</u>	Facility Name: Rocky Mor	untain Arsenal Basin F								
	Address:									_
	City, State, Zip Code:	Commerce, CO								
	OU# or Site #:									
<u>x</u>	Primary point of contact:	Guggilam Sresty								
^	• •	rch Institute								
	Address: 10 W. 35th Stree									
	City, State, Zip Code:	Chicago, IL 60616								
	Phone #: 312-567-4232	Cincago, IL 00010		amail:						
	Filone #. <u>312-307-4232</u>			eman.						
	Other contacts or vendors wh	no worked on site			No	ne				
	Point of contact:									
	Type: Vendor, Co	onsultant	_Ven	dor, Techni	ical Applicat	tions		Othe	er	
	Organization:									
	Address:									
	City, State, Zip Code:									
	Phone #:			email:						
Ω.	A/QC									
Q,	740									
	_Characteristics of Interest									
	Good pre- and post-trea	atment groundwater data	ı		Go	od pre-	and p	ost-treatmen	t soil data	
	Good temperature prof	file vs. time information			Flu	x asses	sment			
	Groundwater elevation	ıs			Ge	ologic o	cross-s	ection		
	Hydraulic Conductivity	y information								

0295

General Site Information

(General Site Ass	sessment Data					Facility ID	D#: <u>0295</u>
-	Impacted 2	Impacted zone a	s defined by documentation	Width (ft): npacted zone (See source zo		ness (ft):	<u> </u>	Unknown
		Map attachment	3					
-	Monitor W	Vells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
		Number of wells relati	ive to treatment zone:					
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
-	Soil Boring		il borings with pre-treatment					
			il borings with post-treatmer					
		Number inside treatme	ent zone:	_ Number outside	treatment zone:			
2	Types of C	Contaminants						
					Average Pre-treatme	ent Concentration per nical:	Average Post-treatme Chem	ent Concentration per nical:
-		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel	x organochloropesticide	None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
	Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
L					None	None	None	None
	Comme	nts:						
	Attachmen	its:						
		-						
		•						

Hydrogeologic Conceptual Model Facility ID#: 0295 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone _ Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _____ft amsl _ Unknown _ Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: _ Flow direction _ Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: ___ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory __ Field data low ____ Unknown high

Comments:

Attachments:

Thermal treatment:	Conductiv	re.			
memai deadnent.		Resistance _			
	Electrical	_ 3 phase	6 phase	AC power	DC power
	Steam	_ 5 p5	0 phase		Be power
		Steam	Steam + air	Steam + O2	2
	X Other (des		<u>——</u>		
Type of Test: <u>x</u>	Pilot test	Full-sca			
Geology of Treatment Zor	ne:	· · · · · · · · · · · · · · · · · · ·	omogeneous and permeal	ble unconsolidated	d sediments
<i>.</i>			omogeneous and imperme		
		_ Largely pern	neable sediments with into	er-bedded lenses	of lower permeability material
	<u>x</u>	Largely impe	ermeable sediments with i	inter-bedded layer	s of higher permeability mater
		_ Competent,	but fractured bedrock (i.e	. crystalline rock)	
		_ Weathered b	pedrock, limestone, sands	tone	
_ Treatment Targe Zone:	Saturated	d only _	Vadose only	Both (Satur	rated and Vadose zones)
Start of Thermal Test:	<u>1992</u>		Duration:	1 month	
_ Hydraulic Control	Yes	No			
_Treatment Cell Design:					
Size of target zone (ft2):		_		Unkr	nown (x :
Thickness of target zone (ft):	1	<u>6</u>	Unkr	nown
Depth to top of target zone	e (ft bgs):	_		Unkr	nown
Thickness of target zone b	elow water table	(ft): _		Unkr	nown
Number of energy delivery	points:	-		Unkr	nown
Number of extraction poin	ts:	_		Unkr	nown
_ Temperature Profile:					
Initial formation temperatu	re (dea C):				Unknown
Maximum representative f		ature (ded C).			Unknown
Time to reach maximum re	•				Unknown
Duration of treatment at re	•				Unknown
2 dianon or troumont at re	,procontative ton	porataro (aayo			<u> </u>
			<u>Dat</u>	<u>e</u>	Temperature (deg C)
Formation temperature im	mediately post-tr	eatment:			
Formation temperature po	st-treatment mor	itoring event 1	: <u></u>		
Duration of post-treatment	monitoring (days	s):			
Mass of contaminant remo					
_	liquid pumping:			1h	lea Unko
				lb	kgUnkn
	apor stream:	-		lb	kgUnkn
Tot	aı.			lb	kgUnkno
Comments:					
Treated	- 50 yd <u>3</u>				
Attachments:	<u> </u>				
, maoninonio.					

Cost and Performance	9				Facility ID#:	<u>0295</u>
Performance						
Remediation Go	al:					
	In Groundwater: —					
	In Soil:					
Was the Remed	iation Goal Achieved:					
	Comment: —					
	_					
	x In Soil					
	Comment:					
	<u>97</u>	to 99% destruction in s	soils neated to 25	ouc or nigner		
General comme	nts on the thermal applica	ition:				
Lessons Learne	d					
Energy						
Total Energy Us	eq.		kWhr	kWhr/m ³	k\	Whr/vd ³
	Total energy applied to tr	rootmont zono:	KWIII	KVVIII/III	kWhr/m ³	kWhr/yd ³
		eatment zone.			_ kWhr/m ³	
	Other energy:				KVVIII/III	KVVIII/yu
	Please i	note other energy:				
Cost						
Total Project Co	st:					
	Consultant Cost:					
	Thermal Vendor Cost:					
	Energy Cost:			m ³	yd ³	
· · · · · · · · · · · · · · · · · · ·	Other Cost 1:					
	Other Cost 2:					
· · · · · · · · · · · · · · · · · · ·	Other Cost 3:					
· · · · · · · · · · · · · · · · · · ·	e other cost:	Other Cost 1:				
7 10000 1100		Other Cost 2:				
	_					
		Other Cost 3:				

File Analyzed By: JT	<u>x</u>	PD					Date:	9/26/200
Type of treatment:	<u>x</u>	Conductive		_Steam	ERH	Other:		
Type of Contaminant:	<u>x</u>	Chlorinated Solv	vents	_	Petroleum Hydroca	rbons	Pesticides	
		_Wood Treating			Other:			
Treatment Status:		_Active	<u>x</u>	Post				
Type of Test:		_Pilot Test	<u>x</u>	Full Scale	e System			
Start of Test:	3/3/	2002		End	of Test: 3/15/2002		Duration: 12 da	<u>ıys</u>
Type of Site:		_Non-DOD	<u>s</u>	DoD				
Facility Name: Rocky M	ountair	n Arsenal						
Address:								_
City, State, Zip Code:	Con	nmerce City, CO						
OU# or Site #: Hex Pit								
Primary point of contact:	Ralp	oh Baker						
Organization: <u>TerraThe</u>	rm							
Address: 356 Broad Stre	<u>et</u>							
City, State, Zip Code:	Fitc	hburg, MA 01420	ļ					
Phone #: 978-343-0300				email: rba	ker@terratherm.com			
Other contacts or vendors v	ho wo	rked on site			None			
Point of contact: Ke	rry Guy	!						
Type:Vendor,			_ Ven	dor, Techni	cal Applications	<u>x</u> Oth	ner <u>regulator</u>	
Organization: EPA Reg	ion 8				• •	_		
Address:								
City, State, Zip Code:								
Phone #: 303-312-7288				email: guv	.kerry@epa.gov			
<u> </u>				<u>g</u> ,				
QA/QC								
Characteristics of Interes	t							
Good pre- and post-ti		it groundwater dat	a		Good pre- and	l post-treatme	nt soil data	
Good temperature pro		-			Flux assessme	•		
Groundwater elevation		c miormation			Geologic cros			
Hydraulic Conductiv					Geologie elos	5 SCCIOII		

0300

General Site Information

General Site As	ssessment Data					Facility I	D#: <u>0300</u>
<u>x</u> Impacted	Zone: Length (parallel to flow	w direction)(ft.): <u>below</u>	Width (ft):	Thick	kness (ft):		Unknown
	Impacted zone a	as defined by documentation	1				
	Alternative meth	nod for determining size of in	npacted zone (See source zo	ne definition attachme	nts)		
	Map attachment	t					
<u>x</u> Monitor \	Wells: Number of relevant r	monitoring wells with ground					x None
			Pre-treatment:		Post-treatment:		
		tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin		oil borings with pre-treatmen					
		oil borings with post-treatment.					
	Number inside treatm	ent zone:	_ Number outside	treatment zone:			
	0						
x Types of 0	Contaminants						
					ent Concentration per		nent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	mical: Soil (mg/kg)	Groundwater (mg/L)	mical: Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None None	None	None	None
	Tetrachloroethene	Jet Fuel	x aldrin	None	100 mg/kg	None	10 mg/kg
	1.1-dichloroethene	Napthalene	x dieldrin	None	10,000 mg/kg	None	100 mg/kg
	cis-1,2-dichloroethene	Benzene	x chlorodane	None	100 mg/kg	None	None
	trans-1,2-dichloroethene	Tolune	x endrin	None	100 mg/kg	None	None
	1,1-dichloroethane	Ethylbenzene		None	100 mg/kg	None	None
	1,2-dichloroethane	m/p-xylene	x ene isodrin nexacniorocyciopentau x ene	None	10,000 mg/kg	None	1,000 mg/kg
	1,1,1-trichloroethane	o-xylene	x hexachlorobenzene	None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane		x hexachlorobutadiene	None	None	None	None
001100111	1,1,2,2-tetrachloroethane		x dioxin/furan	None	100 mg/kg	None	100 mg/kg
	Vinyl Chloride			None	None	None	None
	x Carbon Tetrachloride			None	5 mg/kg	None	5 mg/kg
	x Chloroform			None	5 mg/kg	None	1 mg/kg
	x <u>Tetrachloroethene</u>			None	1 mg/kg	None	1 mg/kg
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
		<u>Thre</u>	ee stated impacted areas o	of 3200 yd3, 2550 yd3	3, and 2005 yd3		
Attachme	nts:						
	-						

<u>×</u>	Geology.	Zone	Unconsolidated Sediments				
		Vadose Zone:	x Relatively homogeneo	us and permeable u	nconsolidated sedir	nents	
			Relatively homogeneo	us and impermeable	e unconsolidated se	diments	
			Largely permeable sec	diments with inter-be	edded lenses of lowe	er permeabili	itv material
			Largely impermeable s			•	•
					-	gnor ponnea	ionity material
			Competent, but fractur				
			Weathered bedrock, lin				
		Saturated Zone:	x Relatively homogeneo	us and permeable u	inconsolidated sedir	nents	
			Relatively homogeneo	us and impermeable	e unconsolidated se	diments	
			Largely permeable sec	liments with inter-be	edded lenses of lowe	er permeabili	ity material
			Largely impermeable s	ediments with inter-	bedded layers of hi	gher permea	bility material
			Competent, but fractur	ed bedrock (i.e. crys	stalline rock)		
			Weathered bedrock, lin	nestone, sandstone	:		
<u>x</u>	Ground surface ele	vation based on wells in o	adjacent to treatment zone:	5280	ft amsl		Unknown
<u>x</u>	Aquifer Characteris	tics:					
	Is more than 1 aqui	fer present?	No Yes (num	ber):	<u>x</u> Unkı	nown (assume	single aquifer)
			Aquifer 1	Aquifer 2	Aquifer 3		
	Depth to water:	low value (ft bgs):	10				
	·	high value (ft bgs):	14				
		Unknown:					
		OTIKITOWIT.					
	Floredination		NATE				
<u>x</u>	Flow direction		<u>NNE</u>				
<u>X</u>	Horizontal hydraulic	gradient (feet/foot):	0.008				Unknown
	Vertical hydraulic gr	radient (feet/foot):				<u>x</u>	Unknown
<u>x</u>	K range (ft/day)	Measured	using: Slug Test	Laborato	ory	Field data	
		low				<u>x</u>	Unknown
		high			_		
	Transmissivity (ft2/d	day): Measured	using: Slug Test	Laborato	ory	Field data	
	• •	low	· — ·			_ <u>x</u>	Unknown
		high				-	
		riigii					
	_						
	Comments:						
	_						
	=						
	Attachments:						
	_						
	_						

The	rmal Treatment - Design					Facility ID#: 0300
<u>x</u>	Thermal treatment:	<u>x</u> Conductive				
		Electrical Resistance	ce			
		3 phase	е .	6 phase	AC power	DC power
		Steam Steam	-	Steam + air	Steam + O2	2
		Other (describe)				
<u>x</u>	Type of Test: <u>s</u>	Pilot test1	Full-scale Sy	stem		
	_ Geology of Treatment Zone	e: <u>x</u> Relati	vely homog	eneous and permea	able unconsolidate	d sediments
		Relati	vely homog	eneous and imperm	neable unconsolida	ted sediments
		Large	ly permeabl	e sediments with in	ter-bedded lenses	of lower permeability material
		Large	ly impermea	able sediments with	inter-bedded layer	s of higher permeability material
		Comp	etent, but fr	actured bedrock (i.e	e. crystalline rock)	
		Weath	nered bedro	ck, limestone, sand	stone	
<u>x</u>	Treatment Targe Zone:	Saturated only	<u>x</u> '	Vadose only	Both (Satur	rated and Vadose zones)
<u>x</u>	Start of Thermal Test:	3/3/2002		Duration	: <u>12 days</u>	
<u>s</u>	Hydraulic Control	Yes <u>x</u> !	No			
<u>x</u>	Treatment Cell Design:					
_	Size of target zone (ft2):		<u>4512</u>		Unkr	nown (<u>94</u> x <u>45</u> ft)
	Thickness of target zone (ft	·):	12		Unkr	· — — ·
	Depth to top of target zone	,	<u></u>		Unkr	
	Thickness of target zone be		<u>0</u>		Unkr	
	Number of energy delivery		<u>=</u> 266		Unkr	
	Number of extraction points		<u>56</u>		Unkr	
	Tamanatura Drafila					
<u>s</u>	Temperature Profile:	o (dog C):		10		I Indonesia
	Initial formation temperature		۰« C)،	<u>10</u>		Unknown
	Maximum representative fo		- '	<u>213</u>		Unknown
	Time to reach maximum rep	•		<u>12</u>		Unknown
	Duration of treatment at rep	resentative temperature	e (days):	<u>1</u>		Unknown
				<u>Da</u>	<u>te</u>	Temperature (deg C)
	Formation temperature imm	nediately post-treatment:	:			
	Formation temperature pos	t-treatment monitoring e	event 1:	-		
	Duration of post-treatment i	monitoring (days):				
	_ Mass of contaminant remov	/ed:				
	Via li	iquid pumping:			lb	kg Unknown
	In va	apor stream:			lb	kg Unknown
	Tota	l:			lb	kgUnknown
	Comments:					
	6 ft spaciı	ng with borings comple	eted at 12.	5 ft bgs		
	Attachments:					

Performa			Facility ID#: 0300
	nce		
Remedia	tion Goal:		
	In Groundwa	ter:	
	<u>x</u> In Soil: <u>9</u>		COC (hex. aldrin, dieldrin, endrin, isodrin, and chlorodane) and reduce oncentrations of 6 COCs below the ROD HHE criteria
Was the	Remediation Goal Achieve	ed:	
	In Groundwa	ter	
	Comme		
	In Soil		_
	Comme		
00	and the street of	annliantian.	
General	comments on the thermal a	application:	
Lessons	Learned		
trea 5. <u>C</u> hav Energy	ergy Used:	different than previously en neutralization of acids;	6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³
t <u>rea</u> 5. <u>C</u> hav Energy	ergy Used: Total energy applie	different than previously en neutralization of acids;	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhr kWhr/m³ kWhr/yd³ kWhr/yd³ kWhr/yd³
t <u>rea</u> 5. <u>C</u> hav Energy	ergy Used: Total energy: Other energy:	different than previously enneutralization of acids; ed to treatment zone:	ncountered; 4. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³
trea 5. <u>C</u> hav Energy	ergy Used: Total energy: Other energy:	different than previously en neutralization of acids;	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhr kWhr/m³ kWhr/yd³ kWhr/yd³ kWhr/yd³
trea 5. <u>C</u> hav Energy	ergy Used: Total energy: Other energy:	different than previously enneutralization of acids; ed to treatment zone:	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhr kWhr/m³ kWhr/yd³ kWhr/yd³ kWhr/yd³
treated to the state of the sta	ergy Used: Total energy: Other energy:	different than previously enneutralization of acids; ed to treatment zone:	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhr kWhr/m³ kWhr/yd³ kWhr/yd³ kWhr/yd³
treated to the state of the sta	ergy Used: Total energy applie Other energy:	different than previously enneutralization of acids; ed to treatment zone:	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhr kWhr/m³ kWhr/yd³ kWhr/yd³ kWhr/yd³
treated to the state of the sta	ergy Used: Total energy applie Other energy: pet Cost:	ed to treatment zone:	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³kWhr/m³kWhr/yd³
treated to the state of the sta	ergy Used: Total energy applie Other energy: percent Cost: Consultant Cost:	ed to treatment zone:	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³kWhr/m³kWhr/yd³
trea 5. L hav Energy Total Ene	table waste are qualitively to not assume 90% in-situ e ability to confirm flow. argy Used: Total energy applie Other energy: P ject Cost: Consultant Cost: Thermal Vendor C	ed to treatment zone:	4. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³
treated to the state of the sta	ergy Used: Total energy applie Other energy: Consultant Cost: Thermal Vendor C Energy Cost:	ed to treatment zone: lease note other energy:	4. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³
treated to the state of the sta	itable waste are qualitively on ot assume 90% in-situ e ability to confirm flow. Pargy Used: Total energy applie Other energy: Property: Consultant Cost: Thermal Vendor Company Cost: X Other Cost 1: X Other Cost 2:	ed to treatment zone: lease note other energy: ost:	4. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³
Energy Total Ene Cost Total Pro	ergy Used: Total energy applie Other energy: Consultant Cost: Thermal Vendor C Energy Cost: Other Cost 1:	ed to treatment zone: lease note other energy: ost: 195470 370000	4. Insulate if abnormally cold weather could occur. 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³
trea 5. [hav 5. [hav 5. [hav 5.] hav 5. [ha	ergy Used: Total energy applie Other energy: Consultant Cost: Thermal Vendor C Energy Cost: Other Cost 1: Other Cost 2: Other Cost 3:	ed to treatment zone: lease note other energy: ost: 195470 370000	A. Insulate if abnormally cold weather could occur; 6. Use magnehelic gauge taps and ball valves at vapor tea to kWhrkWhr/m³kWhr/yd³ kWhr/m³kWhr/yd³ kWhr/m³ kWhr/yd³ kWhr/m³ kWhr/yd³ yd³ 0 0

___ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	10/26/2006
	Type of treatment:	Conductive	<u>x</u>	Steam	ERH	Other:		
	Type of Contaminant:	<u>x</u> Chlorinated Sol	vents		_ Petroleum Hydro	carbons	Pesticide	s
		Wood Treating			Other:			
	Treatment Status:	Active	<u>x</u>	Post				
	Type of Test:	<u>x</u> Pilot Test		Full Scale	System			
	Start of Test:			End	of Test:		Duration:	
	Type of Site:	x Non-DOD	_	_ DoD				
<u>x</u>	Facility Name: Plating Fa	ucility						
	Address:							
	City, State, Zip Code:	Danbury, CT						
	OU# or Site #:							
<u>x</u>	Primary point of contact:	Jay Dablow						
	Organization: <u>ERM</u>							
	Address: <u>3 Hutton Centre</u>	, Suite 600						
	City, State, Zip Code:	Santa Ana, CA 92707						
	Phone #: <u>714-430-1476</u>			email: jay.o	dablow@erm.com			
	_ Other contacts or vendors w	ho worked on site			None			
	Point of contact:							
	Type:Vendor, C	Consultant	Ver	ndor, Technic	cal Applications	Oth	ier	
	Organization:							
	Address:							
	City, State, Zip Code:							
	Phone #:		-	email:				
Q	A/QC							
	_ Characteristics of Interest	t						
	Good pre- and post-tre	eatment groundwater dat	a		Good pre-	and post-treatme	nt soil data	
	Good temperature pro-	file vs. time information			Flux assess	ment		
	Groundwater elevation	ns			Geologic c	ross-section		
	Hydraulic Conductivit	ty information						

0305

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0305</u>
Impacted	Impacted zone a	v direction)(ft.):			ness (ft):		Unknown
	Alternative meth		pacted zone (See source zo	ne definition attachmer	nts)		
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy			Deather the set		None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
Types of 0	Contaminants						
				Average Pre-treatme	ent Concentration per	Average Post-treatme	ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
							
Attachmer	nts:						

Hydrogeologic Conceptual	I Model		Facility ID#: 0305
Hydrogeologic Conceptual Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of I Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of I Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock)	ediments I sediments ower permeability material of higher permeability material ediments I sediments ower permeability material
Ground surface elev Aquifer Characteristi Is more than 1 aquife	cs:	Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl No Yes (number): L Aquifer 1 Aquifer 2 Aquifer 3	Unknown Jnknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:		- - -
Flow direction			_
Horizontal hydraulic Vertical hydraulic gra			Unknown
K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data Unknown
Transmissivity (ft2/da	high	using:Slug TestLaboratory	Field data Unknown
Comments:			
Attachments:			

The	ermal Treatment - Design							Facility ID#:	0305
<u>x</u>	Thermal treatment:		_ Conductiv	/e					
			Electrical	Resistance					
		<u>x</u>	Steam	_ 3 phase	_	6 phase	AC pow	verDC	power
		_	Other (des	Steam	_	Steam + air	Steam +	· O2	
<u>x</u>	Type of Test: <u>x</u>	Pilo	_ Other (des		I-scale Syst	em			
~	_ Geology of Treatment Zon				-	neous and permea	able unconsolida	ated sediments	
	_ 0,		· <u></u>		_	neous and imperm			
				_ Largely p	ermeable	sediments with in	ter-bedded lens	es of lower permea	ability material
				_ Largely ir	mpermeab	le sediments with	inter-bedded la	yers of higher perr	neability material
				_ Compete	nt, but fra	ctured bedrock (i.e	e. crystalline roc	k)	
				_ Weather	ed bedrocl	k, limestone, sand	stone		
	_ Treatment Targe Zone:		_ Saturated	d only	Va	adose only	Both (Sa	aturated and Vadose	zones)
_	_ Start of Thermal Test:					Duration	:		
_	_ Hydraulic Control	_	_ Yes	No					
	_ Treatment Cell Design:								
	Size of target zone (ft2):						II	nknown (_ x ft)
	Thickness of target zone (f	t):						nknown	_
	Depth to top of target zone	•	as):					nknown	
	Thickness of target zone b			(ft):				nknown	
	Number of energy delivery	point	ts:				U	nknown	
	Number of extraction point	s:					U	nknown	
_	_ Temperature Profile:								
	Initial formation temperatur	e (de	eg C):					Unknown	ı
	Maximum representative for	ormat	tion tempera	ature (deg C	C):			Unknown	1
	Time to reach maximum re	prese	entative tem	nperature (d	days):			Unknown	1
	Duration of treatment at re	prese	entative tem	perature (d	ays):			Unknown	ı
						Do	to	Tomporotu	ro (dog C)
	Formation temperature imr	media	ately nost-tr	eatment:		<u>Da</u>	<u>ie</u>	<u>Temperatu</u>	re (deg C)
	Formation temperature pos				nt 1·				
	Duration of post-treatment			-				-	
	·		3 ()	,					
_	_ Mass of contaminant remo	ved:							
	Via	liquid	l pumping:	_			lb	kg	Unknow
	In va	apor s	stream:	_			lb	kg	Unknow
	Tota	al:					lb	kg	Unknow
	Comments:								
	Attachments:								
								· <u> </u>	

t and Performance					Facility ID#:	<u>0305</u>
_ Performance						
Remediation Goal:	_					
	_ In Groundwater: -					
	_ In Soil:					
Was the Remediation						
	_ In Groundwater					
	Comment: -					
	-					
	_ In Soil					
	Comment: -					
	-					
General comments of	n the thermal applica	ation:				
Lessons Learned						
_ Energy						
Total Energy Used:			kWhr	kWhr/m ³	kV	Vhr/vd ³
	al energy applied to t	treatment zone:	ĸ ‹‹ m		kWhr/m ³	kWhr/y
Othe					_ kWhr/m ³	kWhr/y
Otne				_	_ KVVIII/III	KVVIII/Y
	Please	note other energy:				
Cost						
Total Project Cost:						
-	sultant Cost:					
	rmal Vendor Cost:					
	rgy Cost:	-		_ m ³	_ yd ³	
·	er Cost 1:			-'''	_ yu	
						
	er Cost 2:					
	er Cost 3:	011 0 11				
Please note oth	er cost:	Other Cost 1:				
		Other Cost 2:				

Other Cost 3:

<u>x</u> PD ____ File Analyzed By: Date: 10/18/2006 ____Steam Type of treatment: ___ Conductive ____Other: Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: X Treatment Status: ___ Active Post X Type of Test: <u>x</u> Pilot Test Full Scale System Start of Test: End of Test: <u>3/9/1997</u> 2/7/1997 Duration: 30 d Type of Site: DoD ____Non-DOD <u>X</u> Facility Name: <u>Dover Air Force Base</u> Address: City, State, Zip Code: Dover, DE OU# or Site #: Primary point of contact: Tim McHale Organization: **Dover National Test Site** Address: Bldg 909 Arnold Drive Ext City, State, Zip Code: Dover AFB, DE 19902 Phone #: 302-677-4103 email: timothy.mchale@dover.af.mil Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0310

General Site Information

Impacted	Zone: Length (parallel to flo	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unk
	Impacted zone	as defined by documentation					
	Alternative met	nod for determining size of im	pacted zone (See source	ce zone definition attachmer	its)		
	Map attachmen	t					
x Monitor \	Wells: Number of relevant	monitoring wells with ground	water data:				None
			Pre-treatm	ent: <u>6</u>	Post-treatment:		
		tive to treatment zone:		5			
	Pre-treatment	=	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
Soil Borin	gs: Number of relevant s	oil borings with pre-treatment	data:				
	Number of relevant s	oil borings with post-treatmer	nt data:				
	Number inside treatm	nent zone:	_ Number ou	tside treatment zone:			
Types of 0	Contaminants	1	1			1	
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chei	ent Concent
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	· · · · · · · · · · · · · · · · · · ·						
Comme	erits.						
		orn Thou wood two troopro	that mimicked DNAPI	, i.e. Perfluoromethylcyclo	hexane (PMCH) on	d perfluorotrimethyou	clohevano

___ Slug Test

___ Laboratory

_ Unknown

Unknown

Field data

low

high

low

high

Transmissivity (ft2/day):

Comments:

Attachments:

8.5

27.8

Measured using:

The	rmal Treatment - Design									Facility	ID#:	<u>0310</u>	
<u>x</u>	Thermal treatment:		_ Conductive	e									
		<u>x</u>	Electrical l	Resistance									
				_ 3 phase		<u>x</u>	6 phase		_ AC powe	er	DC I	ower	
		_	_ Steam	-									
			-	_ Steam			Steam + air		_ Steam +	O2			
			_ Other (des										
<u>x</u>	Type of Test: <u>x</u>		t test	Full		-							
<u>x</u>	Geology of Treatment Zone	e:					ous and pern						
			-	_	`	_	ous and impe						
			X				diments with					-	
							sediments w				er perm	eability i	materiai
							red bedrock		alline rock	:)			
	Total and Tanas 7.1.						mestone, sa		D .1.(C		., ,	,	
X	Treatment Targe Zone:		_ Saturated	only		Vado	se only	<u>X</u>		turated and `	Vadose z	ones)	
<u>x</u>	Start of Thermal Test:		1997 V				Durat	ion: <u>30 d</u>	:				
	_ Hydraulic Control	_	_ Yes	No									
<u>x</u>	Treatment Cell Design:												
_	Size of target zone (ft2):				900				Un	known	(30) x	30 ft)
	Thickness of target zone (f	t):			15				<u> </u>	known	(=		27 10)
	Depth to top of target zone	•	ns):		20				<u> </u>	known			
	Thickness of target zone be			(ft)·	10					known			
	Number of energy delivery			(11).	6					known			
	Number of extraction points	-			1					known			
	realiser of extraoderi points	.			-					Kilowii			
<u>x</u>	Temperature Profile:												
	Initial formation temperatur	e (de	g C):				<u>14</u>			Uı	nknown		
	Maximum representative for	ormati	ion tempera	ture (deg C	;):		100			Uı	nknown		
	Time to reach maximum re	prese	entative tem	perature (d	ays):		<u>17</u>			Uı	nknown		
	Duration of treatment at rep	prese	ntative tem	perature (da	ays):		<u>13</u>			Uı	nknown		
								<u>Date</u>		Tem	perature	(deg C)
	Formation temperature imp	nedia	tely post-tre	eatment:									
	Formation temperature pos	st-trea	atment moni	itoring even	it 1:								_
	Duration of post-treatment	monit	toring (days):									
	_ Mass of contaminant remo	ved:											
	Via I	liquid	pumping:						_ lb	kg	;		Unknow
	In va	apor s	stream:						_ lb	kg	;		Unknow
	Tota	al:							_ lb	kg	ţ		Unknow
	0												
	Comments:												
	*** ** - 1	onn -	ud2 bu 4b -	hoot outco	dina -	+ +	m the erro	, and at-	om ricir -	upward			
		<u>800)</u>	yus by the	neat exter	idirig 0	ut Irc	m the array	y and ste	am rising	upwara			
	Attachments:												
							<u>-</u>						

Cos	at and Performance					Facility ID#:	<u>0310</u>
	_ Performance						
	Remediation Goal:						
	In Gr	oundwater: —					
	In So	oil:					
	Was the Remediation Goal						
	In Gr						
		Comment: —					
	In Co						
	In So	_					
		Comment: —					
	General comments on the ti	hermal applica	ation:				
	Goal of the project wa	s to see if SPI	H would remove DNA	PL from the subsu	<u>urface</u>		
	Lessons Learned						
	-						
	-						
<u>x</u>	Energy						
	Total Energy Used:	200000		<u>x</u> kWhr	kWhr/m ³		/hr/yd ³
	Total energ	gy applied to to	reatment zone:			kWhr/m ³	kWhr/yd ³
	Other ener	gy:	-			kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
	Cont						
	Cost Total Project Cost:						
	Consultant	Cost					
		endor Cost:					
	Energy Co				m^3	yd³	
					'''	yu	
	Other Cost						
	Other Cost						
	Other Cost		Other Cout 4:				
	Please note other cos	ı:	Other Cost 1:				
		_	Other Cost 2:				
			Other Cost 3:				

<u>X</u> PD ____ File Analyzed By: Date: 11/9/2006 ____Steam Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: \underline{X} Post Active Type of Test: Pilot Test ___ Full Scale System Start of Test: 8/18/1999 End of Test: 7/12/2000 Duration: 203 d Type of Site: Non-DOD __ DoD Facility Name: Cape Canaveral Address: City, State, Zip Code: Florida OU# or Site #: LC34 Primary point of contact: Jackie Quinn Organization: Kennedy Space Center Address: City, State, Zip Code: Phone #: 321-867-8410 email: jacqueline.w.quinn@nasa.gov Other contacts or vendors who worked on site _ None Point of contact: Stephen Antonioli Type: <u>X</u> Vendor, Consultant __ Vendor, Technical Applications __Other Organization: MSE Technology Application Address: PO Box 4078; 200 Technology Way City, State, Zip Code: Butte, MT 59702 Phone #: email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0330

General Site Information

x	(Impacted	Zone:	Length (narallel to flo	w direction)(ft.):		Width (ft):	Thick	ness (ft):		<u>x</u>	Unknown				
X Impacted Zor		20110.	= "	as defined by documentation		widar (it).	THICK			Δ	Chillown				
						had ==== (Caa aauraa ==	no definition ettechnica	ta)							
			Alternative method for determining size of impacted zone (See source zone definition attachments)												
			Map attachment												
×	Monitor V	Velle:	Number of relevant monitoring wells with groundwater data: None												
	<u> </u>	vens.	Pre-treatment: 10 Post-treatment: 10												
			Number of wells rela	Number of wells relative to treatment zone:											
			Pre-treatment	In: 6	ı	Ipgradient:	Downgradient:	ssgradient:							
			Post-treatment	-		Ipgradient:	Downgradient:		Crossgradient:						
. 35 todation in o oppusione Downgasione Olossylauient															
χ	Soil Boring	gs:	Number of relevant so	oil borings with pre-treatmen	t dat	a:									
			Number of relevant soil borings with post-treatment data:												
			Number inside treatm	ent zone:		Number outside	treatment zone:								
Σ	Types of C	ontaminar	its												
							Avaraga Pra traatma	ent Concentration per	Average Post-treatm	ant Co	oncentration per				
							Chen			mical:	meentration per				
_		Ch	lorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)				
	Chemicals of Concern	X Tricl	nloroethene	Hexane	_	Creosote	None	None	None		None				
		Tetra	achloroethene	Jet Fuel	X	TCE - Shallow	1,000 mg/L	100 mg/kg	500 mg/L	5	60 mg/kg				
		1,1-0	lichloroethene	Napthalene	X	TCE - Mid	1,000 mg/L	1,000 mg/kg	100 mg/L	50	00 mg/kg				
		cis-1	,2-dichloroethene	Benzene	x	TCE - Deep	1,000 mg/L	5,000 mg/kg	500 mg/L	10	00 mg/kg				
		trans	-1,2-dichloroethene	Tolune	<u>X</u>	cis-12 DCE - Shallow	5 mg/L	1 mg/kg	10 mg/L		None				
		1,1-0	lichloroethane	Ethylbenzene	<u>x</u>	cis-12 DCE - Mid	10 mg/L	10 mg/kg	50 mg/L		None				
		1,2-dichloroethane		m/p-xylene	<u>x</u>	cis-12 DCE - Deep	10 mg/L	1 mg/kg	50 mg/L		None				
		1,1,1	-trichloroethane	o-xylene	x	Trans-12 DCE	None	None	None		None				
		1,1,2	-trichloroethane		<u>X</u>	Trans-12 DCE	None	None	0.5 mg/L		None				
		1,1,2	,2-tetrachloroethane		X	Trans-12 DCE	None	None	0.05 mg/L		None				
		Viny	l Chloride		<u>x</u>	VC - Shallow	None	None	5 mg/L		None				
					<u>x</u>	VC - Mid	None	None	1 mg/L		None				
					<u>X</u>	VC - Deep	None	None	0.05 mg/L		None				
					-		None	None	None		None				
					-		None	None	None		None				
					-		None	None	None		None				
L							None	None	None		None				
	Comme	nto.													
	Comme	1115.													
						Area contained ar	estimated 11313 kg	of_							
		<u>T0</u>	TCE Soil Samples fro and vinyl chloride where all ND for pre-demo soil samples and for post-treatment trans (shallow) groundwater												
	Attachmer	nts:													
		_													
		_													

0330

General Site Assessment Data

<u>X</u>	Geology:	<u>Zone</u>		Uncon	solidated	Sedime	ents_							
		Vadose Zon	ne:	R	Relatively h	homoge	eneous a	and perme	eable und	onsolidate	d sediments			
				R	Relatively h	homoge	eneous a	and imperi	meable u	nconsolida	ited sediments			
	<u>x</u> Largely permeable sediments with inter-bedded lenses of the control of the									of lower perme	ability material			
					.argely imp	permea	ble sedi	ments witl	h inter-be	dded laye	rs of higher per	meability material		
				c	Competent	t, but fra	actured I	oedrock (i	.e. crysta	lline rock)				
				v	Veathered	d bedroo	ck, limes	tone, san	dstone					
	Saturated Zone: Relatively homogeneous and permeab									onsolidate	d sediments			
				R	Relatively homogeneous and impermeable unconsolidated sediments									
				<u>x</u> L	argely per	rmeable	e sedime	ents with in	nter-bedo	led lenses	of lower perme	eability material		
					argely imp	permea	ermeable sediments with inter-bedded layers of higher permeability material							
				c	Competent	t, but fra	actured I	oedrock (i	.e. crysta	lline rock)				
				v	Veathered	d bedroo	ck, limes	tone, san	dstone					
<u>x</u>	Ground surface	elevation based on	wells in o	r adjace	nt to treat	tment z	one:	<u>5</u>		ft amsl	_	Unknown		
<u>X</u>	Aquifer Charact													
	Is more than 1 a	aquifer present?		No	x	Yes (number)	_				sume single aquifer)		
					uifer 1			quifer 2		Aquifer 3	3			
	Depth to water:	,	0 /	1		4	<u>16</u>							
		high value (ft bgs):	<u>5</u>		-								
		Unknown:												
	.													
	_ Flow direction													
<u>x</u>	Harizantal hydr	aulic gradient (feet/f	foot):	0.00000	09 to 0.000°	7 (000005	to 0.0008				Unknown		
^	Vertical hydraul	0.00000	19 10 0.000	<u>/ </u>	.0000003	10 0.0008				Unknown				
	vertical flydraul	ne gradient (rection	π).									Chkhown		
<u>x</u>	K range (ft/day)		Measured	usina.		Slug T	est	I.	aboratory		Field da	ata		
	rrango (rraay)		low	uog.		. O.ug .	001		acorator,			Unknown		
			high						_					
	Transmissivity (Measured	using:		Slug T	est	L	aboratory		Field da	ata		
	•		low						-		<u> </u>	Unknown		
		1	high											
	Comments:	Upper sand unit	K= 0.14	to 13.7	7 ft/day	avera	ge 9.7 ft	/day						
		ft/day averag	e - 3.2 ft/c									K= 2.1 to 4.9 wer Sand unit K=		
	<u>ft/day average - 3.2 ft/day</u>										Jana ann. 11-			
	Attachments:													
		-												

The	rmal Treatment - Design							Facility ID#:	0330		
<u>x</u>	Thermal treatment:	Conductiv	/e								
		<u>x</u> Electrical	Resistance								
			_ 3 phase		6 phase	_	AC power	DC	power		
		Steam									
			Steam		Steam + air	_	_ Steam + C	02			
		Other (de									
<u>x</u>	Type of Test: <u>x</u>	Pilot test		scale System							
<u>x</u>	Geology of Treatment Zone	_ ′	•	us and permeal							
			-	-	· ·			ated sediments	1.99		
		<u>X</u>						s of lower permea	-		
		_						ers of higher pern	neability material		
			_		out fractured bedrock (i.e. crystalline rock) edrock, limestone, sandstone						
~	Treatment Targe Zone:	Saturate	 '			<u>x</u>	Both (Sati	arated and Vadose	zones)		
<u>x</u>	Start of Thermal Test:	8/18/1999	u Offiy	v ado.	Duration:			irated and vadose	zones)		
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No		Duration.	203	<u>u</u>				
	riyaraano comuci	<u>A</u> 100									
<u>x</u>	Treatment Cell Design:										
_	Size of target zone (ft2):			<u>3750</u>			Unk	cnown (x ft)		
	Thickness of target zone (ft	t):		<u>42</u>			Unk	cnown			
	Depth to top of target zone	(ft bgs):		<u>3</u>			Unk	cnown			
	Thickness of target zone be	elow water table	(ft):	<u>41</u>			Unk	known			
	Number of energy delivery		<u>13</u>			Unk	cnown				
	Number of extraction points		<u>12</u>			Unk	cnown				
	_ Temperature Profile:										
	Initial formation temperature	e (deg C):			<u>26</u>			Unknown			
	Maximum representative fo	ature (deg C)):					Unknown			
	Time to reach maximum re	nperature (da	ays):					Unknown			
	Duration of treatment at rep	oresentative tem	perature (da	ys):				Unknown			
					Dat	е		Temperatui	re (dea C)		
	Formation temperature imn	nediately post-tr	eatment:			_					
	Formation temperature pos										
	Duration of post-treatment	monitoring (day	s):								
<u>x</u>	Mass of contaminant remov	ved:									
	Via I	iquid pumping:					_ lb	kg	Unknow		
	In va	apor stream:					_ lb	kg	Unknow		
	Tota	l:		2150		<u>x</u>	lb	kg	Unknow		
	Comments:										
	2 conduc	tive intervals o	f 23 to 30 ft	bgs and 38	3 to 45 ft bgs.						
	Attachments:										

Performance Remediation Goal: In Groundwater: FL cleanup of GW of 3 ug/L of TCE In Soil: Reach FL cleanup goal for TCE in soil of 30 ug/kg Was the Remediation Goal Achieved: __ In Groundwater Comment: __ In Soil Comment: General comments on the thermal application: Objective: 1) Remove 90% of TCE mass in saturated zone 2) State of FL cleanup goals 3) Clean silt and clay stringers 4) Remove DNAPL pools from depressions in clay aquitard 5) Avoid mobilization Lessons Learned Energy __ kWhr/yd³ Total Energy Used: kWhr ___ kWhr/m³ kWhr/yd³ x Total energy applied to treatment zone: 1725000 kWhr kWhr/m³ __ Other energy: kWhr/m³ _ kWhr/yd³ _ Please note other energy: Cost Total Project Cost: 568742 ____ Consultant Cost: __ Thermal Vendor Cost: _ yd³ x Energy Cost: 72484 ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1: _ Other Cost 2:

Other Cost 3:

Facility ID#:

0330

Cost and Performance

File Analyzed By: <u>X</u> PD ____ Date: 11/9/2006 Type of treatment: Conductive <u>X</u> Steam ERH ____ Pesticides Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active X Post Type of Test: Pilot Test Full Scale System Start of Test: 7/19/2001 End of Test: 12/28/2001 Duration: 160 d Type of Site: Non-DOD __ DoD Facility Name: Cape Canaveral Address: City, State, Zip Code: Florida OU# or Site #: LC34 Primary point of contact: Jackie Quinn Organization: Kennedy Space Center Address: City, State, Zip Code: Phone #: 321-867-8410 email: jacqueline.w.quinn@nasa.gov Other contacts or vendors who worked on site _None Point of contact: Type: <u>X</u> Vendor, Consultant __ Vendor, Technical Applications __Other Organization: <u>IWR</u> Address: City, State, Zip Code: Santa Barbara, CA Phone #: 805-966-7757 email: _ QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data __ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information _ Flux assessment ____ Groundwater elevations _Geologic cross-section

Facility ID#:

0340

General Site Information

X Impacted Zone: Length (parallel to flow direction)(ft.): Width (ft): Thickness (ft): Impacted zone as defined by documentation Alternative method for determining size of impacted zone (See source zone definition attachments)	X Unknown
Impacted zone as defined by documentation	<u>X</u> Unknown
Alternative method for determining size of impacted zone (See source zone definition attachments)	
Map attachment	
X Monitor Wells: Number of relevant monitoring wells with groundwater data:	None
Pre-treatment: $\underline{6}$ Post-treatment: $\underline{6}$	
Number of wells relative to treatment zone:	
Pre-treatment In: 6 Upgradient: Downgradient: Crossgradient:	
Post-treatment In: 6 Upgradient: Downgradient: Crossgradient:	
X Soil Borings: Number of relevant soil borings with pre-treatment data: 13	
Number of relevant soil borings with post-treatment data: 14	
Number inside treatment zone: 4 Number outside treatment zone: 4	
100000000000000000000000000000000000000	
X Types of Contaminants	
	nent Concentration per mical:
Chlorinated Solvents Petroleum Hydrocarbons Other Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L)	Soil (mg/kg)
X Trichloroethene Hexane Creosote None None None	None
TetrachloroetheneJet Fuel X TCE - Shallow 500 mg/L 50 mg/kg 100 mg/L	50 mg/kg
1,1-dichloroetheneNapthalene X TCE - Mid 100 mg/L 1,000 mg/kg 10 mg/L	1,000 mg/kg
cis-1,2-dichloroetheneBenzene X TCE - Deep 500 mg/L 1,000 mg/kg 100 mg/L	1,000 mg/kg
trans-1,2-dichloroethene Tolune X cis-12 DCE - Shallow 10 mg/L None 0.5 mg/L	None
1,1-dichloroethane Ethylbenzene X cis-12 DCE - Mid 100 mg/L None 1 mg/L	None
	None
	None
Chemicals of	
Olitoni — V	None
	None
	None
X VC - Mid 10 mg/L None 0.1 mg/L	None
<u>X VC - Deep</u> 100 mg/L None 0.1 mg/L	None
	None
	None
	None
None None None	None
Comments:	
Colline III.	
Shallow treatment zone from 18 to 24 ft; Intermediate treatment zone from 25 to 28 ft; Deep from 41 to 44 ft Soil Samples from cis-12-DCE, trans-12-DCE, and vinyl chloride where allI ND for	oro domo camplo
Con Campies from Cis-12-DOL, trais-12-DOL, and virgi Chloride where all ND 101	no demo sample
Attachments:	
Allaviiiloito.	

Hydrogeologic Conceptual Model Facility ID#: 0340

<u>x</u>	Geology:	<u>Zone</u>		Unconsolidated :	<u>Sediments</u>			
		Vadose Zone	e:	Relatively h	omogeneous	and permeable	unconsolidated sedi	ments
				Relatively h	omogeneous	and impermeal	ole unconsolidated se	ediments
				x Largely per	meable sedir	nents with inter-	bedded lenses of low	er permeability material
				Largely imp	ermeable se	diments with inte	er-bedded layers of h	igher permeability material
				Competent	, but fractured	d bedrock (i.e. cr	ystalline rock)	
				Weathered	bedrock, lime	estone, sandstor	ne	
		Saturated Zo	ne:	Relatively h	nomogeneous	and permeable	unconsolidated sedi	ments
				Relatively h	nomogeneous	and impermeal	ole unconsolidated se	ediments
				x Largely per	meable sedir	nents with inter-	bedded lenses of low	er permeability material
				Largely imp	ermeable se	diments with inte	er-bedded layers of h	igher permeability material
				Competent	, but fractured	d bedrock (i.e. cr	ystalline rock)	
				Weathered	bedrock, lime	estone, sandstor	ne	
<u>x</u>	Ground surface	elevation based on	wells in o	r adjacent to treati	ment zone:	<u>5</u>	ft amsl	Unknown
<u>x</u>	Aquifer Charact	teristics:						
	Is more than 1	aquifer present?		No <u>x</u>	Yes (numbe	r): <u>2</u>	Unl	known (assume single aquifer)
				Aquifer 1	,	Aquifer 2	Aquifer 3	
	Depth to water:	low value (ft	bgs):	1	<u>46</u>			
		high value (ft	t bgs):	<u>5</u>				
		Unknown:						
	_ Flow direction							
<u>x</u>	Horizontal hydr	aulic gradient (feet/fo	oot):	0.000009 to 0.0007	0.00000	5 to 0.0008	<u>_</u>	Unknown
	Vertical hydraul	ic gradient (feet/foot):					Unknown
<u>X</u>	K range (ft/day)		/leasured	using:	Slug Test	Labora	atory	_ Field data
			OW					Unknown
			igh			s		
	Transmissivity (• • •	/leasured	using:	Slug Test	Labora	atory	_ Field data
			OW	-				Unknown
		h	igh					
	0	Lippor good unit	V 011	to 10.7 ft/dov	0.404040 0 7	ft/dov		
	Comments:	Upper sand unit	K= 0.14	10 13.7 IVday	average 9.7	<u>Ivuay</u>	Middle fine-gra	ined unit K= 2.1 to 4.9
			e - 3.2 ft/d				-	Lower Sand unit K=
	Attachaseas	2.7 to 3.3 ft/day	ave	rage - 1.6 ft/day				
	Attachments:							

The	rmal Treatment - Design								Facility	/ ID#:	0340
<u>x</u>	Thermal treatment:		_ Conductive	e							
			_ Electrical I	Resistance							
				_ 3 phase		5 phase		AC powe	r _	DC 1	power
		<u>X</u>	Steam								
				Steam		Steam + air		Steam + 0	02		
			_ Other (des		-						
<u>X</u>	Type of Test: <u>x</u>		t test		-scale System						
<u>X</u>	Geology of Treatment Zon	e:				us and permeat					
				-	_	us and imperme					
			<u>X</u>			iments with inte				-	-
					•			· -	_	ner perm	eability material
						ed bedrock (i.e.	-	iline rock)		
	Total control Total 7-10-1		0-11	- '		nestone, sands		D 4 (C)		** 1	
<u>X</u>	Treatment Targe Zone:	<u>X</u>	Saturated	only	Vados	,			urated and	Vadose 2	zones)
<u>X</u>	Start of Thermal Test:		<u>/2001</u>	NT.		Duration:	160 d	:			
	_ Hydraulic Control	_	_ Yes	No							
~	Treatment Cell Design:										
<u>x</u>	Size of target zone (ft2):				<u>3750</u>			Un	known	(x ft)
	Thickness of target zone (f	+/-			3730 40			Uni		(x it)
	Depth to top of target zone		re).		6			Uni			
	Thickness of target zone b			(ft)·	<u>u</u> 40				known		
	Number of energy delivery			(11).	<u>40</u>				known		
	Number of extraction point		J.		± 18				known		
	reambor of extraotion point	0.			10				KIIOWII		
	_Temperature Profile:										
	Initial formation temperatur	e (de	q C):						ι	Jnknown	
	Maximum representative for			ture (deg C	;):					Jnknown	
	Time to reach maximum re		•							Jnknown	
	Duration of treatment at re				-				t	Jnknown	
	,		·	,							
						Date	<u>e</u>		Ten	nperatur	e (deg C)
	Formation temperature imr	nedia	tely post-tre	atment:	_						
	Formation temperature pos	st-trea	atment moni	toring even	t 1:						
	Duration of post-treatment	monit	toring (days):	_						
<u>x</u>	Mass of contaminant remo	ved:									
	Via	liquid	pumping:	_				lb	k	g	Unknow
	In va	apor s	stream:	_				lb	k	g	Unknow
	Tota	al:			16400		<u>x</u>	lb	k	g	Unknow
	Comments:										
	Attachments:										
		_			-		_	_		_	

Cost and Performance		Facility ID#: 0340
Performance		
Remediation Goal:		
In Groundwater		
in croundwater		
In Soil:		
Was the Remediation Goal Achieved:		
Comment		
In Sail		
In Soil		
Comment		
General comments on the thermal app	lication:	
Primary criterion for success was	s defined as the ability to cost	effectively remove TCF DNAPI
- milary enterior for success was		ost were not included, but were estimated to be \$255,000
Lessons Learned		
F		
Energy		kWhr kWhr/m ³ kWhr/yd ³
Total Energy Used:		
Total energy applied	to treatment zone:	kWhr/m³kWhr/yd³
Other energy:		kWhr/m³ kWhr/yd³
Plea	se note other energy:	
x Cost		
Total Project Cost:	<u>1201175</u>	
Consultant Cost:		
Thermal Vendor Cost		_
	·	 3d3
x Energy Cost:	<u>13902</u>	m³ yd³
Other Cost 1:		
Other Cost 2:		
Other Cost 3:		<u></u>
Please note other cost:	Other Cost 1:	
	Other Cost 2:	
	Other Cost 3:	

General Site Information Facility ID#: 0343 File Analyzed By: <u>x</u> PD ____ Date: Type of treatment: ___ Conductive ____ Steam ____Other: Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: _Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: <u>27-Dec</u> End of Test: 10-Oct Duration: 250 days Type of Site: Non-DOD __ DoD Facility Name: FDOT Greensboro Project Address: City, State, Zip Code: Greensboro, FL OU# or Site #: Primary point of contact: Jimmy Bailey Organization: Florida Department of Transportation Address: PO Box 607 City, State, Zip Code: Chipley, Florida 32428-0607 Phone #: email: __ Other contacts or vendors who worked on site _None Point of contact: David Rountree Type: Vendor, Consultant ___ Vendor, Technical Applications __Other Organization: WRS Infrastructure & Environment, Inc. Address: 625 East Tennessee Street, Suite 100 City, State, Zip Code: Tallahassee, FL 32308-4939 Phone #: 850-531-9860 email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

<u>x</u>	Impacted 2	Impacted zone	ow direction)(ft.): 40 as defined by documentation thod for determining size of in		_	ness (ft):		<u>x</u> Unknown				
x	Monitor W	Vells: Number of relevant	monitoring wells with ground	onitoring wells with groundwater data:								
		Number of wells rel	ative to treatment zone:									
		Pre-treatmen		Upgradient:	Downgradient:	Cros	ssgradient:					
		Post-treatmer	nt In:	Upgradient:	Downgradient:	Cros	ssgradient:					
:	Soil Borings: Number of relevant soil borings with pre-treatment data: Number of relevant soil borings with post-treatment data: Number inside treatment zone: Number outside treatment zone:											
<u>x</u> .	Types of C	Contaminants										
					Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:				
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
		Trichloroethene	Hexane	Creosote	None	None	None	None				
		Tetrachloroethene	Jet Fuel	x <u>Diesel</u>	5,000 mg/L	None	None	None				
		1,1-dichloroethene	Napthalene	x Gasoline (BTEX)	5,000 mg/L	None	None	None				
		cis-1,2-dichloroethene	x Benzene		50 mg/L	None	1 mg/L	None				
		trans-1,2-dichloroethene	x Tolune		10 mg/L	None	0.1 mg/L	None				
		1,1-dichloroethane	<u>x</u> Ethylbenzene		1 mg/L	None	0.1 mg/L	None				
		1,2-dichloroethane	x m/p-xylene		None	None	None	None				
		1,1,1-trichloroethane	x o-xylene		None	None	None	None				
	micals of oncern	1,1,2-trichloroethane	x Total xylenes		5 mg/L	None	1 mg/L	None				
		1,1,2,2-tetrachloroethane	x MTBE		1 mg/L	None	0.1 mg/L	None				
		Vinyl Chloride			None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
,	Commer		All COCs were n	nondetect in post treatmen	nt samples but they did	I not give the detecti	on limit.					

Facility ID#:

0343

General Site Assessment Data

<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			Largely permeable sediments with inter-bedded lenses of lower permeability material
			x Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			Largely permeable sediments with inter-bedded lenses of lower permeability material
			x Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
<u>x</u>	Ground surface ele	vation based on wells in	or adjacent to treatment zone: 255 ft amsl Unknown
<u>x</u>	Aquifer Characteris	itics:	
	Is more than 1 aqui	fer present?	No <u>x</u> Yes (number): <u>3</u> Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3
	Depth to water:	low value (ft bgs):	<u>10</u>
		high value (ft bgs):	
		Unknown:	
<u>x</u>	Flow direction		N-NE
<u>x</u>	Horizontal hydraulio	c gradient (feet/foot):	0.005752Unknown
	Vertical hydraulic g	radient (feet/foot):	<u>x</u> Unknown
<u>x</u>	K range (ft/day)	Measured	l using: Slug Test Laboratory Field data
		low	1.91 Unknown
		high	5.19
	Transmissivity (ft2/	day): Measured	l using: Slug Test Laboratory Field data
		low	<u>x</u> Unknown
		high	
	Comments:		
	_		
	-		
	Attachments:		
	_		
	_		

The	rmal Treatment - Design											Facility ID#	<i>‡</i> :	<u>0343</u>
<u>x</u>	Thermal treatment:		_ Cond	luctive	;									
		<u>x</u>	Elect	rical R	Resista	nce								
				-	3 pha	ase		6 p	hase		_ AC power	r	DC	power
			Steam	n										
					Stear	n		Ste	am + air		_ Steam + C	02		
	T (T)	-		r (desc										
<u>X</u>	Type of Test:	_ Pilot	test			_		ystem		-1-1				
<u>x</u>	Geology of Treatment Zone	э:				-		_	•			ed sediments		
						-		-	-			lated sedimer		hilibu mantavial
												•		bility material
				<u>x</u>	_	-	-				talline rock)		Jeiiii	eability material
						-			stone, sand	-	tailine rock,	,		
<u>x</u>	Treatment Targe Zone:		_ Satu	rated	_	illiolo		Vadose o		<u>X</u>	Roth (Sati	urated and Vac	lose ·	zonec)
<u>x</u>	Start of Thermal Test:	2-Jai	_	ratou	Omy			· radose o	Duration			arated and vac	1050 2	iones)
<u>x</u>	Hydraulic Control		Yes		x	No			Baration	. 250	days			
_	,		_		_									
<u>x</u>	Treatment Cell Design:													
	Size of target zone (ft2):						4305				Unl	cnown (x ft)
	Thickness of target zone (f	t):					<u>23</u>				Unl	known		
	Depth to top of target zone	(ft bg	s):				<u>10</u>				Unl	known		
	Thickness of target zone be	elow v	vater t	able ((ft):		<u>13</u>				Unl	known		
	Number of energy delivery	points	3:				9				Unl	known		
	Number of extraction points	s:					<u>16</u>				Unl	known		
<u>x</u>	Temperature Profile:													
	Initial formation temperatur	e (de	g C):					<u>15</u>				Unkn	own	
	Maximum representative for	rmati	on ten	nperat	ture (d	deg C):	<u>60</u>				Unkn	own	
	Time to reach maximum re	prese	ntative	e temp	peratu	ıre (da	ays):	<u>170</u>	<u>)</u>			Unkn	own	
	Duration of treatment at rep	oreser	ntative	temp	eratu	re (da	ıys):	<u>80</u>				Unkn	own	
									<u>Da</u>	ate_		Temper	ratur	e (deg C)
	Formation temperature imr	nediat	ely po	st-tre	atmer	nt:								
	Formation temperature pos	st-trea	tment	monit	toring	event	t 1:	_						
	Duration of post-treatment	monit	oring ((days)):									
	_ Mass of contaminant remo	ved:												
	Via I	iquid	pumpi	ng:							_ lb	kg		Unknown
	In va	apor s	tream	:		_					_ lb	kg		Unknown
	Tota	ıl:									_ lb	kg		Unknown
	Comments:													
	Attachments:													

Facility ID#: Cost and Performance 0343 Performance Remediation Goal: In Groundwater: Source Reduction In Soil: Was the Remediation Goal Achieved: In Groundwater Y Comment: Total VOA (BTEX compounds went from >100,000 ug/L to <200 ug/L. Y In Soil Comment: General comments on the thermal application: Very effective at removing contamination from the ground - contaminant removal rates went up by an order of magnitude. Knowledge of extent of source material is critical to proper design. Target temperature of 70 to 80C. Lessons Learned The remediation worked very well where it was implemented. More detailed knowledge of the contaminant distribution would have resulted in a wider application of the thermal technology. High temperatures of recovered groundwater plus high contaminant concentrations led to chemical compatibility issues not normally seen on petroleum sites. Energy Total Energy Used: kWhr/yd3 <u> 291</u> kWhr __ kWhr/m³ _ Total energy applied to treatment zone: kWhr/m3 kWhr/yd3 _ Other energy: kWhr/m³ kWhr/yd3 Please note other energy: Cost Total Project Cost: __ Consultant Cost: __ Thermal Vendor Cost: yd³ __ Energy Cost: ___ Other Cost 1: Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1:

> Other Cost 2: Other Cost 3:

File Analyzed By: PD ____ Date: 10/26/2006 Type of treatment: Conductive ___ Steam ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: _Active Post Type of Test: Pilot Test Full Scale System Start of Test: 2/21/2005 End of Test: 5/16/2005 Duration: 85 d Type of Site: Non-DOD _ DoD Facility Name: Confidential Europe Address: City, State, Zip Code: Europe OU# or Site #: Primary point of contact: James Baldock Organization: Address: City, State, Zip Code: Phone #: 01865 384 800 email: James.baldock@erm.com Other contacts or vendors who worked on site _ None Point of contact: Ross Pollock Type: _ Vendor, Consultant ___ Vendor, Technical Applications __Other Churngold Remediation Ltd Organization: Address: City, State, Zip Code: Phone #: 0117 916 0510 email: ross.pollock@churngold.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data __ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _Geologic cross-section

Facility ID#:

0347

General Site Information

(General Site As	sessme	nt Data					Facility ID	D#: <u>0347</u>
-	Impacted	Zone:	Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):	<u> </u>	Unknown
			Alternative metho	od for determining size of im	pacted zone (See source zo	ne definition attachmen	its)		
_	Monitor V	Vells:	Number of relevant m	onitoring wells with groundy					None
			Number of wells relati	ve to treatment zone:	Pre-treatment:		Post-treatment:		
			Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
			Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
_	Soil Boring	gs:	Number of relevant so	il borings with pre-treatment	data:				
			Number of relevant so	il borings with post-treatmen	t data:				
			Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Х	Types of C	Contami	nants						
						Average Pre-treatme	ent Concentration per	Average Post-treatme	ent Concentration per
			Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
Γ			richloroethene	Hexane	Creosote	None	None	None	None
			Cetrachloroethene	Jet Fuel		None	None	None	None
			,1-dichloroethene	Napthalene		None	None	None	None
			is-1,2-dichloroethene	Benzene		None	None	None	None
			rans-1,2-dichloroethene	Tolune		None	None	None	None
			,1-dichloroethane	Ethylbenzene		None	None	None	None
			.2-dichloroethane	m/p-xylene		None	None	None	None
			,1,1-trichloroethane	o-xylene		None	None	None	None
	Chemicals of					None	None	None	None
	Concern			x total xylenes x Ethylbenzene		None	None	None	None
			/inyl Chloride	<u>x</u> <u>Emyloenzene</u>		None	None	None	None
			hloroethane			None	None	None	None
		<u>x</u> <u>c</u>	moroemane			None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
٢		l				None	None	None	None
	Comme	nts:							
		-							
		-							
		-							
	Attachmer	nts:							
	, macriffet								
		-							

Hydrogeologic Concep	otual Model		Facility ID#:	0347
Geology:	<u>Zone</u>	Unconsolidated Sediments		
	Vadose Zone:	Relatively homogeneous and permeable unconsolidated s	sediments	
		Relatively homogeneous and impermeable unconsolidate	d sediments	
		Largely permeable sediments with inter-bedded lenses of	lower permeability material	
		Largely impermeable sediments with inter-bedded layers	of higher permeability materi	al
		Competent, but fractured bedrock (i.e. crystalline rock)		
		Weathered bedrock, limestone, sandstone		
	Saturated Zone:	Relatively homogeneous and permeable unconsolidated s	sediments	
		Relatively homogeneous and impermeable unconsolidate	d sediments	
		Largely permeable sediments with inter-bedded lenses of	lower permeability material	
		Largely impermeable sediments with inter-bedded layers	of higher permeability materi	al
		Competent, but fractured bedrock (i.e. crystalline rock)		
		Weathered bedrock, limestone, sandstone		
Ground surface e	elevation based on wells in	or adjacent to treatment zone: ft amsl	Unknown	
Aquifer Characte	eristics:			
Is more than 1 ac	quifer present?	No Yes (number):	Unknown (assume single aquife	er)
		Aquifer 1 Aquifer 2 Aquifer 3		
Depth to water:	low value (ft bgs):		_	
	high value (ft bgs):		_	
	Unknown:		_	
Flow direction			_	
Horizontal hydrau	ulic gradient (feet/foot):		Unknown	
Vertical hydraulic	gradient (feet/foot):		Unknown	
K range (ft/day)	Measured	l using: Slug Test Laboratory	Field data	
	low		Unknown	
	high		_	
Transmissivity (ft	2/day): Measured	l using: Slug Test Laboratory	Field data	
	low		Unknown	
	high		_	
Comments:				
				_
Attachments:				_

The	rmal Treatment - Design								Facility ID#:	<u>0347</u>
<u>x</u>	Thermal treatment:		_ Conduc	ctive						
		<u>x</u>	Electric	cal Resistance						
			-	3 phase		6 phase		AC power	DO	C power
			_ Steam							
			-	Steam		Steam + air	-	Steam + O2		
				describe)						
<u>x</u>	Type of Test:	_ Pilot		_	-scale System					
	_ Geology of Treatment Zone	э:	· <u>-</u>		_	ous and permeal				
			-	-	_	ous and imperme				
			-			diments with inte				-
			-						s of higher per	meability material
			-			red bedrock (i.e.	-	alline rock)		
	Tractment Torge Zone		- Coture	ted only		imestone, sands		Dath (Catum	atad and Vadaa	
<u>X</u>	Treatment Targe Zone: Start of Thermal Test:		_	ned only	Vado	•	<u>X</u>	Botn (Satur	ated and Vadose	e zones)
<u>X</u>	Hydraulic Control		/2005 Yes	No		Duration:	<u>83 u</u>			
<u>x</u>	Tryuraulic Control	<u>x</u>	168	No						
<u>x</u>	Treatment Cell Design:									
-	Size of target zone (ft2):				17222			Unkn	own (_ x ft)
	Thickness of target zone (f	t):						<u>x</u> Unkn		
	Depth to top of target zone		ıs):					<u>x</u> Unkn		
	Thickness of target zone be			ole (ft):				<u>x</u> Unkn	own	
	Number of energy delivery				<u>25</u>			Unkn	own	
	Number of extraction points	S:			<u>23</u>			Unkn	own	
	_ Temperature Profile:									
	Initial formation temperatur	e (dec	a C):						Unknow	n
	Maximum representative for		- '	erature (deg C	C):				Unknow	
	Time to reach maximum re								Unknow	
	Duration of treatment at rep								Unknow	n
						<u>Date</u>	<u>e</u>		Temperatu	ure (deg C)
	Formation temperature imp	nediat	tely post	-treatment:						
	Formation temperature pos	st-trea	tment m	onitoring ever	nt 1:					
	Duration of post-treatment	monit	oring (da	ays):						
<u>x</u>	Mass of contaminant remove	ved:								
	Via I	iquid	pumping	g:				lb	kg	Unknown
	In va	apor s	tream:	_				lb	kg	Unknown
	Tota	ıl:			2000			lb	<u>x</u> kg	Unknown
	Comments:									
	Attachments:									

and Performance					Facility ID#:	0347
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
-						
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k۱	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m ³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:		· —	_ KVVIII/III	KVVIII/yC
	Flease	note other energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
·	ermal Vendor Cost:					
	ergy Cost:			m ³	_ yd³	
	her Cost 1:				- /~	
	her Cost 1:	-				
	her Cost 3:					
· 		Other Cost 1:				
Please note of	mer cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD						Date:	5/12/2005
	Type of treatment:	Conductive		_Steam	<u>X</u>	ERH	Other:		
	Type of Contaminant:	X Chlorinated Solv	ents	<u>X</u>	Petr	oleum Hydro	ocarbons	Pesticides	
		Wood Treating			_ Othe	er:			
	Treatment Status:	Active	<u>X</u>	Post					
	Type of Test:	Pilot Test	X	Full Scale					
	Start of Test:	10/3/2002		End	of Test	t: <u>2/17/2003</u>		Duration: 138d	
	Type of Site:	Non-DOD	_	_ DoD					
<u>X</u>		iney Star Center							
	Address:								-
	City, State, Zip Code:	Largo, FL							
	OU# or Site #: Northeast	Site Area A							
v	Deimon point of contact.	In Daniel							
<u>X</u>	Primary point of contact:	Joe Daniel							
		Corporation							
	Address: 7887 Bryan Dair								
	City, State, Zip Code:	<u>Largo, FL 33777</u>		., .		0 . 1			
	Phone #: 727-549-0603			emaii: joe.	daniei	@gjo.doe.go	<u>v</u>		
<u>X</u>	Other contacts or vendors wh	no worked on site				_None			
	Point of contact: <u>Jack</u>	Craig							
	Type:Vendor, C	onsultant	_Ven	dor, Techni	cal Ap	plications	<u>s</u> Oth		
	Organization: <u>Department</u>	nt of Energy							
	Address: 7887 Bryan Dair	y Road, Suite 195							
	City, State, Zip Code:	Largo, FL 33777							
	Phone #: 412-386-4754			email: jack	.craig	@lm.doe.gov	<u></u>		
Q.	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	atment groundwater data	ı			Good pre-	and post-treatme	nt soil data	
	Good temperature prof	ile vs. time information				_Flux asses	sment		
	Groundwater elevation	ıs				_Geologic o	eross-section		
	Hydraulic Conductivity	y information							

Facility ID#:

0350

General Site Information

ž	<u>x</u> Impacted	Zone:		v direction)(ft.): 550 us defined by documentation od for determining size of im				ness (ft):	35	Unknown
			Map attachment							
	<u>x</u> Monitor V	Vells:	Number of relevant m	nonitoring wells with ground						None
			Number of wells relate	ive to treatment zone:	Pre	-treatment:	<u>6</u>	Post-treatment:	<u>24</u>	
			Pre-treatment	In: 6	Upgradient:		Downgradient:		Crossgradient:	
			Post-treatment	In: 16	Upgradient:	6	Downgradient:	·	Crossgradient:	
			r ost treatment	III. <u>10</u>	opgradient.	<u>u</u>	Downgradient.	=	orossgradient	
	x Soil Boring	gs:	Number of relevant so	il borings with pre-treatment	data:	<u>36</u>				
			Number of relevant so	il borings with post-treatmer	nt data:	<u>20</u>				
			Number inside treatme	ent zone: 40	Nun	nber outside	treatment zone:	<u>16</u>		
2	x Types of C	Contamina	nts	T						
							Average Pre-treatme	ent Concentration po nical:		ment Concentration per
-		CI	hlorinated Solvents	Petroleum Hydrocarbons	Othe	r	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
l		<u>x</u> Tric	chloroethene	Hexane	Creosote		5 mg/L	5 mg/kg	0.001 mg/L	0.1 mg/kg
l		Tet	rachloroethene	Jet Fuel			None	None	None	None
l		1,1-	-dichloroethene	Napthalene			None	None	None	None
l		x cis-	1,2-dichloroethene	Benzene			1 mg/L	5 mg/kg	0.005 mg/L	0.1 mg/kg
l		tran	s-1,2-dichloroethene	x Tolune			1 mg/L	0.1 mg/kg	0.001 mg/L	0.1 mg/kg
l		1,1-	dichloroethane	Ethylbenzene			None	None	None	None
l		1,2-	dichloroethane	m/p-xylene			None	None	None	None
l	Chemicals of	1,1,	1-trichloroethane	o-xylene			None	None	None	None
l	Concern		2-trichloroethane				None	None	None	None
l		1,1,	2,2-tetrachloroethane				None	None	None	None
l		Vin	yl Chloride				None	None	None	None
l		x Me	thylene Chloride				5 mg/L	1 mg/kg	0.005 mg/L	0.1 mg/kg
l				x FL PRO			None	50 mg/kg	None	10 mg/kg
l							None	None	None	None
l							None	None	None	None
l							None	None	None	None
L							None	None	None	None
	Comme	nts:								
	00111110	_								
		_								
					<u>, </u>			<u>-</u>		
	Attachmer	nts:								
		_								

Facility ID#:

0350

General Site Assessment Data

<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sediments	
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments	
			Relatively homogeneous and impermeable unconsolidated sediments	
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material	
			Largely impermeable sediments with inter-bedded layers of higher permeability materi	al
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments	
			Relatively homogeneous and impermeable unconsolidated sediments	
			 <u>x</u> Largely permeable sediments with inter-bedded lenses of lower permeability material 	
			Largely impermeable sediments with inter-bedded layers of higher permeability materi	al
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
x	Ground surface el	levation based on wells in	or adjacent to treatment zone: 17 ft amsl <u>x</u> Unknown	
<u>x</u>	Aquifer Character	istics:		
	Is more than 1 aq	uifer present?	No Yes (number): X Unknown (assume single aquife	er)
			Aquifer 1 Aquifer 2 Aquifer 3	
	Depth to water:	low value (ft bgs):	1 (Average 5)	
		high value (ft bgs):	<u> </u>	
		Unknown:		
<u>x</u>	Flow direction		<u>ESE</u>	
<u>x</u>	Horizontal hydrau	lic gradient (feet/foot):	<u>0.002</u> Unknown	
	Vertical hydraulic	gradient (feet/foot):	Unknown	
<u>x</u>	K range (ft/day)	Measure	d using: Slug Test Laboratory Field data	
		low	<u>0.99</u> Unknown	
		high	7.1	
	Transmissivity (ft2	2/day): Measure	d using: Slug Test Laboratory Field data	
		low	Unknown	
		high		
		_		
	Comments:			
	,	Vertical K = 1.06e-6 to 1	1.06e-4 cm/s	
			ft/day and n=0.3 for 20 ft/yr	
	Attachments:			
	-			
	-			

The	rmal Treatment - Design							Facility ID#:	0350
<u>x</u>	Thermal treatment:	Co	onductive						
		<u>x</u> El	ectrical Resis	tance ETDS	<u>P</u>				
			3 p	hase	6 phase		AC power	DC	power
		X St	eam						
			Ste	am	Steam + air		Steam + O2		
		Ot	ther (describe)						
<u>x</u>	Type of Test:	Pilot test	t <u> </u>	Full-scale S	ystem				
<u>x</u>	Geology of Treatment 2	Zone:	<u></u>		geneous and perr				
					geneous and imp				
					le sediments with			•	•
					able sediments w			s of higher perr	neability material
			<u> </u>	·	ractured bedrock ock, limestone, sa		alline rock)		
<u>x</u>	Treatment Targe Zone:	S	aturated only		Vadose only	<u>X</u>	Roth (Satura	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	10/3/200	,		-	<u>^</u> :ion: 138d		ned and vadose	zones)
<u>x</u>	Hydraulic Control	<u>x</u> Ye		No	Durac	.ion. <u>1500</u>			
_	,	_		_					
<u>x</u>	Treatment Cell Design:								
	Size of target zone (ft2)):		10000	!		Unkno	own (<u>10</u>	<u>00</u> x <u>100</u> ft)
	Thickness of target zon	e (ft):		<u>35</u>			Unkno	own	
	Depth to top of target z	one (ft bgs):		<u>0</u>			Unkno	own	
	Thickness of target zon	e below wate	er table (ft):	<u>30</u>			Unkno	own	
	Number of energy deliv	ery points:		<u>78</u>			Unkno	own	
	Number of extraction po	oints:		<u>28</u>			Unkno	own	
<u>x</u>	Temperature Profile:								
_	Initial formation temper	ature (deg C)):		<u>28</u>			Unknown	
	Maximum representativ	e formation t	temperature	(deg C):	<u>100</u>			Unknown	
	Time to reach maximur	n representa	tive tempera	ture (days):	<u>68</u>			Unknown	
	Duration of treatment a	t representat	ive temperat	ure (days):	<u>70</u>			Unknown	
						_		_	
	Formation to an areturn	ina na a di atale.				<u>Date</u>		Temperatu	re (deg C)
	Formation temperature Formation temperature				2/19/2003 4/23/2003			105 85	
	Duration of post-treatm	•		g event 1.	4/23/2003			<u>65</u>	
	Daraner er poet a cam.		.g (uu) 0/.						
<u>x</u>	Mass of contaminant re	emoved:							
	,	/ia liquid pun	nping:				lb	kg	Unknown
	I	n vapor strea	am:				lb	kg	Unknown
	7	Γotal:		9920	O or 3880	X	lb	kg	Unknown
	Comments: Mass	removed pr	ovides the	high and low	calculations				
	floor 1	10/3/02 to 10	<u>0/22/02</u> aı	nd steam+EF	RH 10/23/02 to	2/17/03	Heating	cycles - ERH	only for hot Volume treated
) yd3 (1816							
	Attachments:								

				Fa	cility ID#:	<u>0350</u>
Performance						
Remediation Goa	l:					
<u> 1</u>	In Groundwa	iter: ug/L TCE 1100	0: cic 1 2 DCE 50	000: mathylana chlarid	40 30000.	Toluono 5500:
		<u>ug/L - ICE - I100</u>		<u>000: methylene chloric ГРН - 50000</u>	de - 20000:	Toluene - 5500:
2	n Soil:					
		mg/kg - TCE - 20.4; c	is-1,2-DCE - 70; me	ethylene chloride -227;	Toluene -	15; TPH - 2500
Was the Remedia	ation Goal Achieve	ed:				
2	In Groundwa	ter				
	Comm	ent:				
		<u>yes</u>				
2	n Soil	<u> </u>				
	Comm	ent:				
		<u>yes</u>				
General commen	ts on the thermal	application:				
Target temp	oroture of 04C					
rargot torri	erature or 64C					
· · · · · · · · · · · · · · · · · · ·						
Lessons Learned						
· · · · · · · · · · · · · · · · · · ·						
-						
-						
Lessons Learned		so toologique for movimizing	a moos tomoval			
Lessons Learned		e technique for maximizin	g mass removal			
Lessons Learned		e technique for maximizin	g mass removal			
Lessons Learned	e cycling is effectiv	re technique for maximizin 0 E9 BTU	g mass removal kWhr	kWhr/m³		
1) Pressure Energy Total Energy Use	e cycling is effectived:					
1) Pressure Energy Total Energy Use	e cycling is effectived:	<u>0 E9 BTU</u>				
1) Pressure Energy Total Energy Use	e cycling is effectiv d: <u>1</u> Fotal energy appli Other energy:	<u>0 E9 BTU</u>				hr/yd ³ kWhr/yd ³ kWhr/yd ³
1) Pressure _ Energy Total Energy Use	e cycling is effectiv d: <u>1</u> Fotal energy appli Other energy:	<u>0 E9 BTU</u> ed to treatment zone:				
1) Pressure Energy Total Energy Use	e cycling is effectived: d: Total energy appli Other energy: —— F	0 E9 BTU ed to treatment zone: lease note other energy:				
1) Pressure Energy Total Energy Use Cost Total Project Cos	e cycling is effectived: d: 1 Total energy applice 2 1 1 1 1 1 1 1 1 1 1 1 1	<u>0 E9 BTU</u> ed to treatment zone:				
1) Pressure Energy Total Energy Use Cost Total Project Cos	e cycling is effective d: 1 Fotal energy application Other energy:	0 E9 BTU ed to treatment zone: lease note other energy: 3800000				
1) Pressure Energy Total Energy Use Cost Total Project Cos	d: 1 Total energy appli Other energy: F t: Consultant Cost:	0 E9 BTU ed to treatment zone: lease note other energy: 3800000		kV	Vhr/m ³ Vhr/m ³	
1) Pressure Energy Total Energy Use Cost Total Project Cos	d: 1 Fotal energy appli Other energy: t: Consultant Cost: Thermal Vendor Cenergy Cost:	0 E9 BTU ed to treatment zone: lease note other energy: 3800000			Vhr/m ³ Vhr/m ³	
1) Pressure _ Energy Total Energy Use Cost Total Project Cos	d: 1 Total energy appli Other energy:	0 E9 BTU ed to treatment zone: lease note other energy: 3800000		kV	Vhr/m ³ Vhr/m ³	
1) Pressure Energy Total Energy Use Cost Total Project Cos	d: 1 Total energy appli Other energy: F t: Consultant Cost: Thermal Vendor C Energy Cost: Other Cost 1: Other Cost 2:	0 E9 BTU ed to treatment zone: lease note other energy: 3800000		kV	Vhr/m ³ Vhr/m ³	
1) Pressure Energy Total Energy Use Cost Total Project Cos	d: 1 Total energy appli Other energy:	o E9 BTU ed to treatment zone: lease note other energy: 3800000 ost:		kV	Vhr/m ³ Vhr/m ³	
1) Pressure Energy Total Energy Use Cost Total Project Cos	d: 1 Total energy appli Other energy:	0 E9 BTU ed to treatment zone: lease note other energy: 3800000		kV	Vhr/m ³ Vhr/m ³	

____ Other Cost 3:

File Analyzed By: <u>X</u> PD ____ Date: 11/15/2006 Type of treatment: _Conductive ____ Steam X ERH Type of Contaminant: _____Pesticides Chlorinated Solvents X Petroleum Hydrocarbons _ Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: ____ Pilot Test X Full Scale System Start of Test: End of Test: 5/15/2006 Duration: Type of Site: __Non-DOD __ DoD Facility Name: Young Rainey Star Center Address: City, State, Zip Code: Largo, FL OU# or Site #: Northeast Site Area B Primary point of contact: Paul Darr Organization: SM Stoller Corporation Address: 2597 B 314 Rd City, State, Zip Code: Grand Junction, CO 81503 Phone #: 970-248-7666 email: paul.darr@gjo.doe.gov Other contacts or vendors who worked on site _ None Point of contact: Jack Craig Type: __ Vendor, Consultant _____ Vendor, Technical Applications Other Department of Energy Organization: Address: City, State, Zip Code: Phone #: email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section ___ Hydraulic Conductivity information

Facility ID#:

0360

General Site Information

General Site As	ssessment Data					Facility II	D#: <u>0360</u>
Impacted	5 ".		Width (ft):	Thick	ness (ft):	_	Unknown
	 -	as defined by documentation					
		=	pacted zone (See source zo	ne definition attachmen	its)		
	Map attachment						
Monitor V	Wells: Number of relevant n	nonitoring wells with groundy			Deather stores		None
	North an of wells as let		Pre-treatment:		Post-treatment:		
		ive to treatment zone:	He was discute	Daniel and disease	0		
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
v Cail Daria	an. Number of valouant on	il basiasa with as treatment	data.				
x Soil Boring		oil borings with pre-treatment					
	Number of relevant so	oil borings with post-treatmen		trootmant sono.			
	Number Inside treatme	ent zone:	Number outside	treatment zone:			
Turnen of (Contaminants						
Types of C	Soniaminanis						
				Average Pre-treatme			ent Concentration per
	CI 1	B. 1 W. 1	0.1	Chen		Chen	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
	Methylene Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ante:						
Commo							
			-		<u></u>		
Attachmer	nte:						
, macrifier							

Yadose Zone:	Hyd	rogeologic Conceptua	I Model					Facility ID#:	0360
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material	<u>x</u>	Geology:	Zone	Unconsolida	ted Sediments				
X Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments X Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Yes (nu			Vadose Zone:	Relative	ely homogeneou	s and permeable	unconsolidated se	diments	
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments x Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifier present? No Yes (number): Aquifier 2 Aquifier 3 Depth to water: low value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown Measured using: Slug Test Laboratory Field data low Unknown Linknown Field data Low Unknown Field data Laboratory Field data				Relative	ely homogeneou	s and impermeab	le unconsolidated	sediments	
Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Example permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Example permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Example permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Example permeability material Example permeabi				<u>x</u> Largely	permeable sedi	ments with inter-b	pedded lenses of lo	ower permeability mat	terial
Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Year Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Yunknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Yes (nu				Largely	impermeable se	ediments with inte	r-bedded layers of	higher permeability r	material
Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments X Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl X Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): X Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): Unknown: Unknown Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown In the province of the pr				Compe	etent, but fracture	d bedrock (i.e. cr	ystalline rock)		
Relatively homogeneous and impermeable unconsolidated sediments x Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone y Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Is more than 1 aquifer present? Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown Field data Iow Unknown Hogh Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Iow Unknown Unknown				Weathe	ered bedrock, lim	estone, sandston	ie		
X Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): X Unknown (assume single aquifer) Aquifer 1			Saturated Zone:	Relative	ely homogeneou	s and permeable	unconsolidated se	ediments	
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Year Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Iow value (ft bgs): Ingh value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Weathered bedrock, limestone, sandstone ft amsl Yea Unknown (assume single aquifer) Aquifer 2 Aquifer 3 Aquifer 3 Aquifer 3 Plow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Iow Iow Iow Iow Iow Iow Iow Io				Relative	ely homogeneou	s and impermeab	le unconsolidated	sediments	
Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Year Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Vertical hydraulic gradient (feet/foot): Unknown (assume single aquifer) Aquifer 1				<u>x</u> Largely	permeable sedi	ments with inter-b	edded lenses of lo	ower permeability mat	terial
Weathered bedrock, limestone, sandstone Weathered bedrock, limestone, sandstone				Largely	impermeable se	ediments with inte	r-bedded layers of	higher permeability r	naterial
Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): x_ Unknown (assume single aquifer) Aquifer 1				Compe	tent, but fracture	d bedrock (i.e. cr	ystalline rock)		
Aquifer Characteristics: Is more than 1 aquifer present?NoYes (number):XUnknown (assume single aquifer) Aquifer 1				Weathe	ered bedrock, lim	estone, sandston	ie		
Flow direction		Is more than 1 aquif	er present?	_				nknown (assume single - -	aquifer)
Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown Unknown K range (ft/day) Measured using: Iow Iow Inknown Unknown High Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown Unknown Unknown			Unknown:					_	
Vertical hydraulic gradient (feet/foot):		_ Flow direction						-	
K range (ft/day) Measured using: Slug Test Laboratory Field data lowUnknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data lowUnknown		_ Horizontal hydraulic	gradient (feet/foot):					Unkno	own
lowUnknown high Transmissivity (ft2/day): Measured using:Slug TestLaboratoryField data lowUnknown		Vertical hydraulic gra	adient (feet/foot):					Unkno	own
lowUnknown high Transmissivity (ft2/day): Measured using:Slug TestLaboratoryField data lowUnknown									
high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown		_ K range (ft/day)	Measured	using:	Slug Test	Labora	tory _	Field data	
Transmissivity (ft2/day): Measured using:Slug TestLaboratoryField dataUnknown			low					Unkno	own
low Unknown			high					-	
		Transmissivity (ft2/d	ay): Measured	using:	Slug Test	Labora	tory _	Field data	
high			low					Unkno	own
			high					_	

Comments:

Attachments:

Vertical K = 1.06e-6 to 1.06e-4 cm/s

Average with Darcys - 1ft/day and n=0.3 for 20 ft/yr

The	rmal Treatment - Design				Facility ID#:	0360
<u>x</u>	Thermal treatment:	Conductive				
		<u>x</u> Electrical Resistance	ce <u>ETDSP</u>			
		3 phas	e 6 phase	AC	power Do	C power
		Steam				
		Steam	Steam + a	ir Stea	m + O2	
		Other (describe)				
<u>x</u>	Type of Test:	Pilot test	Full-scale System			
<u>X</u>	Geology of Treatment Zo	one: Relati	vely homogeneous and pe	ermeable unconso	olidated sediments	
			vely homogeneous and in			
		_	ly permeable sediments w		•	•
			ly impermeable sediments			meability material
			etent, but fractured bedro		rock)	
			nered bedrock, limestone,			
<u>X</u>	Treatment Targe Zone:	Saturated only	Vadose only	_	n (Saturated and Vados	e zones)
	_ Start of Thermal Test:			ation:		
	_ Hydraulic Control	Yes 1	N0			
	_ Treatment Cell Design:					
	Size of target zone (ft2):				_ Unknown (x ft)
	Thickness of target zone	(ft):			Unknown	
	Depth to top of target zor				_ Unknown	
	Thickness of target zone	below water table (ft):			Unknown	
	Number of energy deliver	ry points:			_ Unknown	
	Number of extraction point	nts:			_ Unknown	
	_Temperature Profile:					
	Initial formation temperat	ure (deg C):			Unknow	n
	Maximum representative	formation temperature (de	eg C):		Unknow	n
	Time to reach maximum	representative temperature	e (days):		Unknow	n
	Duration of treatment at r	epresentative temperature	e (days):		Unknow	n
				Data	Townsend	(da = C)
	Formation temperature in	nmediately post-treatment		<u>Date</u>	remperau	ure (deg C)
		nmediately post-treatment ost-treatment monitoring e				
	Duration of post-treatmer	_			· 	
	Daration of poor troutino	it morntoring (dayo).				
<u>x</u>	Mass of contaminant rem	noved:				
	Via	a liquid pumping:	<u>4000</u>	<u>x</u> lb	kg	Unknown
	In	vapor stream:	14000	<u>x</u> lb	kg	Unknown
	To	otal:	18000	<u>x</u> lb	kg	Unknown
	O. Maran		h and law adapted			
		emoved provides the hig			leating cycles - ERI	
		0/3/02 to 10/22/02 and ovd3 (1816000 ft3)	steam+ERH 10/23/02 t	o 2/17/03		Volume treated
	Attachments:					

and Performance					Facility ID#:	0360
_ Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
\\\ 4b - D	O A-					
Was the Remediation						
_						
	Comment: —					
	 In Soil					
_	Comment:					
	Comment.					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k'	Whr/yd ³
To	tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd
	ner energy:				_ kWhr/m³	kWhr/yd
		note other energy:		· —	_ KVVIII/III	KVVIII/yo
	Flease	note other energy.				
Cost						
Total Project Cost:						
-	nsultant Cost:					
	ermal Vendor Cost:					
	ergy Cost:	-		m ³	_ yd³	
	ner Cost 1:				_ yu	
	ner Cost 2:					
	ner Cost 3:		<u> </u>			
Please note of	ther cost:	Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

General Site Information Facility ID#: 0362 File Analyzed By: Date: 1/9/2007 PD ____ ERH Type of treatment: Conductive ____ Steam in situ soil mixing w/steam Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test _Full Scale System Start of Test: Jan-03 End of Test: Duration: _____ Type of Site: ____Non-DOD DoD Facility Name: Cape Canaveral AF Station SLC 15 Pilot Address: City, State, Zip Code: Cape Canaveral, FL OU# or Site #: Space Launch Complex 15, Solid Waste Management Unite (SMWU C030) Primary point of contact: Phil La Mori Organization: **BEM Systems** Address: 2216 South Bentley Ave. #14 City, State, Zip Code: Los Angeles, CA 90064 Phone #: 310-445-9851 email: plamori@bemsys.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment

____ Geologic cross-section

____ Groundwater elevations

General Site As	sessment Data					Facility II	D#: <u>0362</u>
Impacted	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
	Impacted zone a	as defined by documentation	1				
	Alternative meth	od for determining size of im	pacted zone (See source z	one definition attachmer	nts)		
	Map attachment	=					
Monitor V	Vells: Number of relevant n	nonitoring wells with groundy	water data:				None
Worldon's	voils.	normorning wells with grounds	Pre-treatment:		Post-treatment:		None
	Number of wells relat	tive to treatment zone:	i re-deadilent	·	r ost-treatment.		
	Pre-treatment		Upgradient:	Down and die at.	Cana	ssgradient:	
		In:		Downgradient:			
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	-	oil borings with pre-treatment					
		oil borings with post-treatmen					
	Number inside treatme	ent zone:	Number outsid	e treatment zone:			
Types of 0	Contaminants	T		T		I	
				Average Pre-treatme	ent Concentration per	Average Post-treatm	ent Concentration per
					nical:		nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	<u>x</u> Trichloroethene	Hexane	Creosote	500 mg/L	500 mg/kg	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
Concom	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
	x Freon 113			None	None	None	None
	x Total VOCs			500 mg/L	1,000 mg/kg	None	None
	<u>r roun roes</u>			None	None	None	None
				None	None	None	None
				None	None	None	None
							_
				None	None	None	None
Comme	nts:						
	Source wa	s Considered to be ansyw	where widissolved TCE at	ove 10 parts per millio	on (1% solubility) Fe	etimated 582 kg TCE	maee
	Ocurce wa	S SONOIGOTOG TO DE GITSYW	W GIGGOTYEG TOL AL	or in parts per million	170 Solubility). Li	Sumulou GOZ RY TOL	
Attachmer	nte:						
Allacrimer	no						

Hydrogeologic Conceptual Model Facility ID#: 0362

<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sediments
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			x Largely permeable sediments with inter-bedded lenses of lower permeability material
			Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			 <u>x</u> Largely permeable sediments with inter-bedded lenses of lower permeability material
			Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
			
<u>x</u>	Ground surface	e elevation based on wells in	or adjacent to treatment zone: 10 ft amsl Unknown
<u>x</u>	Aquifer Charac	teristics:	
	Is more than 1	aquifer present?	No <u>x</u> Yes (number): <u>2</u> Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3
	Depth to water	low value (ft bgs):	<u>5</u> <u>100</u>
		high value (ft bgs):	
		Unknown:	
			North (usually)
<u>x</u>	Flow direction		sometimes East
<u>x</u>	Horizontal hydi	raulic gradient (feet/foot):	<u>10^-3 to 10^-4</u> Unknown
	Vertical hydrau	lic gradient (feet/foot):	Unknown
<u>x</u>	K range (ft/day) Measure	ed using: Slug Test Laboratory Field data
		low	<u>10</u> Unknown
		high	30
	Transmissivity	(ft2/day): Measure	d using: Slug Test Laboratory Field data
		low	Unknown
		high	
	Comments:		
		Vertical K in clay 0.0001	I ft/day ıy, sand 2 - 0.5 ft/day, sand 3 - 0.1 ft/day, sand 4 - 5 ft/day
			t/day, clay 2 - 1(10^-4) ft/day, clay 3 - 1(10^-4) ft/day, clay 4 - 0.002 ft/day
	Attachments:		

The	rmal Treatment - Design				Facility ID#: 0362	
<u>x</u>	Thermal treatment:	Conductive				_
		Electrical Resistance	-			_
		3 phase	6 phase	AC power	DC power	
		Steam				-
		Steam	Steam + air	Steam + C	2	
	<u>X</u>	Other (describe)	In situ mixing with steam	1		
<u>x</u>	Type of Test: \underline{x} Pilot t	test Full-	scale System			
<u>x</u>	Geology of Treatment Zone:	Relatively	homogeneous and pern	neable unconsolidate	ed sediments	
		Relatively	homogeneous and impe	ermeable unconsolid	ated sediments	
		<u>x</u> Largely pe	ermeable sediments with	n inter-bedded lenses	of lower permeability material	I
		Largely im	permeable sediments w	vith inter-bedded laye	rs of higher permeability mate	rial
		Competen	nt, but fractured bedrock	(i.e. crystalline rock)		
		Weathered	d bedrock, limestone, sa	andstone		
<u>X</u>	Treatment Targe Zone:	Saturated only	Vadose only	x Both (Satu	rrated and Vadose zones)	
<u>X</u>	Start of Thermal Test: <u>Jan-03</u>	<u>3</u>	Durat	ion: 6 months		
	Hydraulic Control	Yes No				
<u>x</u>	Treatment Cell Design:					
	Size of target zone (ft2):		<u>2764</u>	Unk	nown (x	ft)
	Thickness of target zone (ft):		<u>35</u>	Unk	nown	
	Depth to top of target zone (ft bgs	i):	<u>20</u>	Unk	nown	
	Thickness of target zone below wa	ater table (ft):	<u>35</u>	Unk	nown	
	Number of energy delivery points:	:	1 per cell	Unk	nown	
	Number of extraction points:		1 per cell	Unk	nown	
	Tammayatura Drafila					
	_ Temperature Profile:	C):			I I a lan ou an	
	Initial formation temperature (deg				Unknown	
	Maximum representative formatio				Unknown	
	Time to reach maximum represen				Unknown	
	Duration of treatment at represent	lative temperature (da			Unknown	
				Date	Temperature (deg C)	
	Formation temperature immediate	elv post-treatment:			<u> </u>	
	Formation temperature post-treati		 : 1:			
	Duration of post-treatment monito	_				
	, , , , , , , , , , , , , , , , , , , ,	3 (* - 7 - 7				
<u>x</u>	Mass of contaminant removed:					
	Via liquid p	oumping:		lb	kg Unkr	now
	In vapor str	ream:		lb	kg Unkr	now
	Total:			lb	kg Unkr	now
	Comments:					
	Pilot has 32 tes	st cells from 20 to 55	ft			
	Attachments:					

Cost and Performance Facility ID#: 0362 Performance Remediation Goal: In Groundwater: 80% removal In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: __ In Soil Comment: General comments on the thermal application: Goal: reduce the identifiece source are mass by atleast 80% or more to meet the objective of reaching GW cleanup target levels (GCTL) Lessons Learned Energy ____ kWhr/m³ _ kWhr/yd³ Total Energy Used: ____kWhr kWhr/yd³ _ Total energy applied to treatment zone: kWhr/m³ __ Other energy: kWhr/m³ _ kWhr/yd³ _ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: __ Thermal Vendor Cost: ___ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1:

> _ Other Cost 2: _ Other Cost 3:

General Site Information Facility ID#: 0363 File Analyzed By: Date: 1/9/2007 PD ____ Type of treatment: Conductive ____ Steam ERH in situ soil mixing w/steam Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: Mar-04 End of Test: Aug-04 Duration: 6 months Type of Site: DoD ____Non-DOD <u>X</u> Facility Name: Cape Canaveral AF Station SLC 15 Full-scale Address: City, State, Zip Code: Cape Canaveral, FL OU# or Site #: Space Launch Complex 15, Solid Waste Management Unite (SMWU C030) Primary point of contact: Phil La Mori Organization: **BEM Systems** Address: 2216 South Bentley Ave. #14 City, State, Zip Code: Los Angeles, CA 90064 Phone #: 310-445-9851 email: plamori@bemsys.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data

__ Flux assessment

____ Geologic cross-section

____ Good temperature profile vs. time information

___ Hydraulic Conductivity information

____ Groundwater elevations

X Monitor Wells: N X Soil Borings: No No No X Types of Contaminants Chloric X Trichlor — Tetrachle — 1,1-dichl — cis-1,2-d — cis-1,2-d	Alternative method Map attachment Mumber of relevant multiple Mumber of wells relative Pre-treatment Post-treatment umber of relevant soi umber of relevant soi umber inside treatment mated Solvents oothene	s defined by documentation of for determining size of important on the following wells with ground on the following wells with ground on the following with pre-treatment of the followings with pre-treatment of the followings with post-treatment of the followin	water data: Pre-treatme Upgradient: Upgradient: upgradient:	zone definition attachmer	Post-treatment: Cro	16 ssgradient: ssgradient:	None
X Soil Borings: No	Alternative method Map attachment Mumber of relevant multiple Mumber of wells relative Pre-treatment Post-treatment umber of relevant soi umber of relevant soi umber inside treatment mated Solvents oothene	od for determining size of important control of the	water data: Pre-treatme Upgradient: Upgradient: upgradient:	nt: 16 Downgradient: Downgradient: 16 16 16 side treatment zone:	Post-treatment: Cro	ssgradient:	None
X Soil Borings: No	Map attachment Number of relevant m Humber of wells relati Pre-treatment Post-treatment umber of relevant soi umber inside treatment mated Solvents oethene	onitoring wells with grounds ve to treatment zone: In: 16 In: 16 Il borings with pre-treatment il borings with post-treatment ont zone: 16/16	water data: Pre-treatme Upgradient: Upgradient: t data: nt data:	nt: 16 Downgradient: Downgradient: 16 16 16 side treatment zone:	Post-treatment: Cro	ssgradient:	None
X Soil Borings: No	Pre-treatment Post-treatment which is a contract of relevant soi the contract of relevant soil the con	ve to treatment zone: In: 16 In: 16 Il borings with pre-treatment brings with post-treatment and zone: 16/16	Pre-treatme Upgradient: Upgradient: t data: nt data:	Downgradient: Downgradient: 16 16 16 ide treatment zone:	Cro	ssgradient:	None
x Soil Borings: No	Pre-treatment Post-treatment umber of relevant soi umber inside treatme	In: 16 In: 16 In the pre-treatment of the post-treatment of the post-treatment on the post-treatment on the post-treatment on the post-treatment of the po	Upgradient: Upgradient: t data:	Downgradient: Downgradient: 16 16 16 ide treatment zone:	Cro	ssgradient:	
X Soil Borings: No	Pre-treatment Post-treatment umber of relevant soi umber inside treatme	In: 16 In: 16 In the pre-treatment of the post-treatment of the post-treatment on the post-treatment on the post-treatment on the post-treatment of the po	Upgradient: t data:	Downgradient: 16 16 16 1ide treatment zone:	Cro	ssgradient:	
X Types of Contaminants Chlorit X Trichlor — Tetrachl — 1,1-dichl — cis-1,2-d	Post-treatment umber of relevant soi umber inside treatme umber inside treatme	In: 16 Il borings with pre-treatment Il borings with post-treatment Int zone: 16/16	Upgradient: t data: nt data:	Downgradient: 16 16 16 1ide treatment zone:	Cro	ssgradient:	
X Types of Contaminants Chlorit X Trichlor — Tetrachl — 1,1-dichl — cis-1,2-d	umber of relevant soi umber of relevant soi umber inside treatme	ll borings with pre-treatment Il borings with post-treatmer int zone: <u>16/16</u>	t data: nt data:	16 16 Lide treatment zone:			
X Types of Contaminants Chlorit X Trichlor — Tetrachl — 1,1-dichl — cis-1,2-d	umber of relevant soi umber inside treatme	Il borings with post-treatmer int zone: 16/16	nt data:	16 side treatment zone:	ent Concentration per		
X Types of Contaminants Chlorit X Trichlor — Tetrachl — 1,1-dichl — cis-1,2-d	umber inside treatme	nnt zone: <u>16/16</u>		side treatment zone:	ent Concentration per		
Types of Contaminants	nated Solvents		Number out		ent Concentration per		
Chlorir x Trichlor Tetrachl 1,1-dichl cis-1,2-d	oethene	Petroleum Hydrocarbons		Average Pre-treatme	ent Concentration per		
Chlorir <u>X</u> Trichlor Tetrachl	oethene	Petroleum Hydrocarbons		Average Pre-treatme	ent Concentration per		
<u>x</u> Trichlore	oethene	Petroleum Hydrocarbons		Average Pre-treatme	ent Concentration per		
<u>X</u> Trichlor	oethene	Petroleum Hydrocarbons		Cher	nical:	Average Post-treatm Cher	ent Concentra
Tetrachle1,1-dichlecis-1,2-d			Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (m
1,1-dichl	ouoothono	Hexane	Creosote	500 mg/L	500 mg/kg	0.01 mg/L	0.1 mg/k
cis-1,2-d	oroemene	Jet Fuel		None	None	None	None
	loroethene	Napthalene		None	None	None	None
trans-1,2	lichloroethene	Benzene		None	None	None	None
	2-dichloroethene	Tolune		None	None	None	None
1,1-dichl	loroethane	Ethylbenzene		None	None	None	None
1,2-dichl	loroethane	m/p-xylene		None	None	None	None
1,1,1-tric	chloroethane	o-xylene		None	None	None	None
Chemicals of	chloroethane			None	None	None	None
	etrachloroethane			None	None	None	None
Vinyl Cl				None	None	None	None
-				1			None
							0.5 mg/kg
<u> </u>							None
							None
	·						
X Freen 11 X Total VC	13			None 500 mg/L None None	None 1,000 mg/kg None None	None 0.1 mg/L None None	0
				None	None	None	None
				None	None	None	None

Hydrogeologic Conceptual Model Facility ID#: 0363

<u>x</u>	Geology:	<u>z</u>	<u>one</u>	Unconso	lidated Se	ediments						
		Vadose	Zone:	Rel	atively hor	mogeneous a	and permeat	ole unconsolidated s	ediments			
		Relatively homogeneous and impermeable unconsolidated sediments										
				<u>x</u> Lar	<u>x</u> Largely permeable sediments with inter-bedded lenses of lower permeability material							
				Lar	Largely impermeable sediments with inter-bedded layers of higher permeability material							
				Cor	npetent, b	ut fractured b	edrock (i.e.	crystalline rock)				
				We	athered be	edrock, limes	tone, sands	tone				
		Rel	atively hor	mogeneous a	and permeat	ole unconsolidated s	ediments					
		Relatively homogeneous and impermeable unconsolidated sediments X Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock)										
					Weathered bedrock, limestone, sandstone							
						,	,					
<u>x</u>	Ground surface	elevation base	ed on wells in	or adjacent	to treatme	ent zone:	<u>10</u>	ft amsl	Unknown			
<u>x</u>	Aquifer Charact	teristics:										
_	•	Is more than 1 aquifer present?			<u>x</u> ,	Yes (number):	2	1	Unknown (assume single aquifer)			
					er 1	Ac	uifer 2	Aquifer 3				
	Depth to water:	low val	ue (ft bgs):	<u>5</u>		100			_			
	high value (ft bgs):											
	Unknown:					-			_			
						-			_			
<u>x</u>	Flow direction			North (us sometimes					_			
<u>x</u>	Horizontal hydraulic gradient (feet/foot):			10^-3 to 1	0^-4				Unknown			
	Vertical hydraulic gradient (feet/foot):							Unknown				
<u>x</u>	K range (ft/day)		Measure	d usina.	SI	ua Test	Lab	oratory	Field data			
-	low		10		ag . ooi		oratory .	Unknown				
			high	30			<u>_</u>		Chanown			
	Transmissivity (ft2/day): Measured low		_	SI	ug Test	Lab	oratory	_ Field data				
			a doing.		ag root		oratory .	Unknown				
			high						Chkhown			
			riigii						_			
	Comments:											
	Commondo.	Vertical K in										
		K's - sand						<u>y, sand 4 - 5 ft/c</u> 1(10^-4) ft/day,	<u>lay</u> clay 4 - 0.002 ft/day			
	Attachments:	is - cidy	1 - 0.0011	yuay, Ua	<u>y - 1(1(</u>	, −+, π/uay,	ciay 3 -	itio -+/il/uay.	<u> </u>			
	Auachments:											

The	mal Treatment - De	esign							Facility ID#:	0363		
<u>x</u>	Thermal treatment	t:	_ Conductive									
			_ Electrical R	tesistance								
				3 phase	6	phase		AC power	DO	C power		
			_ Steam									
				Steam	S	team + air		_ Steam + O	2			
		<u>x</u>	Other (desc	ribe)	In situ mixing	with steam						
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Full-	scale System							
<u>x</u>	Geology of Treatm	ogy of Treatment Zone: Relativ			homogeneou	s and permeat	ole un	consolidate	d sediments			
			-	vely homogeneous and impermeable unconsolidated sediments								
			<u>x</u>						of lower perme	-		
				Largely impermeable sediments with inter-bedded layers of higher permeability material							material	
				-	Impetent, but fractured bedrock (i.e. crystalline rock)							
		_	_	=		estone, sands						
<u>X</u>	Treatment Targe 2		_ Saturated	only	Vadose	•	<u>X</u>		rated and Vadose	zones)		
<u>X</u>	Start of Thermal T	·				Duration:	6 mc	onths				
	_ Hydraulic Control		_ Yes	No								
v	Treatment Cell De	cian:										
<u>x</u>	Size of target zone	=			27000			Unki	nown (<u>1</u>	55 x	180 ft)	
	Thickness of targe				<u>27900</u>			Unki	_	<u>55</u> x	<u>100</u> It)	
	_		c):		35 10			Unki				
	Depth to top of target zone (ft bgs): Thickness of target zone below water table (ft):			f+\·	-				Inknown			
	_			11).					nknown			
	Number of energy delivery points: Number of extraction points:				1 per cell		Unknown					
	realiser of extracti	ion points.			1 per cen				ilowii			
	Temperature Profi	le:										
	Initial formation ter	mperature (deg	g C):		_				Unknow	n		
	Maximum representative formation temperature (dec				g C):				Unknow	n		
	Time to reach maximum representative temperature Duration of treatment at representative temperature			perature (da					Unknow	n		
								Unknow			'n	
							Temperatu	Temperature (deg C)				
	Formation tempera	atment:										
	Formation tempera	oring even										
	Duration of post-treatment monitoring (days):				_							
<u>x</u>	Mass of contamina	ant removed:										
		Via liquid	pumping:				_	_ lb	kg		Unknown	
	In vapor stream: Total:			<u>13272</u>			_ lb	kg		Unknown		
						<u>x</u> lb <u>kg</u>			Unknown	Unknown		
	Comments:											
		CE only - 423 5 ft bgs) and				Treated 4	48,00	0 yd3 inclu	iding the delu	ge base	d (10 to	
	=	o ir nās) sija	JZJ CEIIS									
	Attachments: _											
	_											

Cost and Performance Facility ID#: 0363 Performance Remediation Goal: In Groundwater: 80% removal In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: __ In Soil Comment: General comments on the thermal application: Goal: reduce the identifiece source are mass by atleast 80% or more to meet the objective of reaching GW cleanup target levels (GCTL) Lessons Learned Energy _ kWhr/yd³ Total Energy Used: kWhr ____ kWhr/m³ kWhr/m³ kWhr/yd³ _ Total energy applied to treatment zone: __ Other energy: kWhr/m³ _ kWhr/yd³ Please note other energy: Cost 1,163,441 (Includes deluge Total Project Cost: basin (\$149/yd3)) ____ Consultant Cost: __ Thermal Vendor Cost: _yd³ ___ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3:

Other Cost 1:
Other Cost 2:
Other Cost 3:

Please note other cost:

Facility ID#: 0364 File Analyzed By: Date: 1/9/2007 PD ____ Type of treatment: Conductive Steam ERH in situ soil mixing w/steam Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: Oct-04 End of Test: Jan-06 Duration: 4 months Type of Site: DoD Non-DOD Facility Name: Cape Canaveral AF Station Deluge Basin Address: City, State, Zip Code: Cape Canaveral, FL OU# or Site #: Space Launch Complex 15, Solid Waste Management Unite (SMWU C030) Primary point of contact: Phil La Mori Organization: **BEM Systems** Address: 2216 South Bentley Ave. #14 City, State, Zip Code: Los Angeles, CA 90064 Phone #: 310-445-9851 email: plamori@bemsys.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

____ Geologic cross-section

General Site Information

____ Groundwater elevations

General Site As	sessment Data					Facility I	D#: <u>0364</u>						
Impacted	Zone: Length (parallel to flow	Length (parallel to flow direction)(ft.): Width (ft): Thickness (ft):											
	Impacted zone a	Impacted zone as defined by documentation											
	Alternative meth	Alternative method for determining size of impacted zone (See source zone definition attachments)											
	Map attachment	Map attachment											
<u>x</u> Monitor V	Vells: Number of relevant n	Number of relevant monitoring wells with groundwater data:											
			Pre-treatment:	<u>31</u>	Post-treatment:	<u>31</u>							
	Number of wells related	tive to treatment zone:											
	Pre-treatment	In: <u>13</u>	Upgradient: 7	Downgradient:	9 Cro	ssgradient: 2							
	Post-treatment		Upgradient: 7	Downgradient:		ssgradient: 2							
		-	-13	. 9	_	_							
x Soil Boring	ns: Number of relevant so	oil borings with pre-treatment	data: <u>23</u>										
<u>x</u> con bonn	=	oil borings with post-treatmen											
	Number inside treatm	= :		e treatment zone:									
	Number inside treatin	ent zone. <u>23/23</u>	Number outside	e treatment zone:									
	Dantania anta												
x Types of C	Contaminants												
					ent Concentration per		nent Concentration per						
					nical:		mical:						
	Chlorinated Solvents x Trichloroethene	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L) 0.01 mg/L	Soil (mg/kg)						
	<u></u>	Hexane	Creosote	500 mg/L	500 mg/kg		0.1 mg/kg						
	Tetrachloroethene	Jet Fuel		None	None	None	None						
	1,1-dichloroethene	Napthalene		None	None	None	None						
	cis-1,2-dichloroethene	Benzene		None	None	None	None						
	trans-1,2-dichloroethene	Tolune		None	None	None	None						
	1,1-dichloroethane	Ethylbenzene		None	None	None	None						
	1,2-dichloroethane	m/p-xylene		None	None	None	None						
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None						
Concern	1,1,2-trichloroethane			None	None	None	None						
	1,1,2,2-tetrachloroethane			None	None	None	None						
	Vinyl Chloride			None	None	None	None						
	x Freon 113			None	None	None	None						
	x Total VOCs			500 mg/L	1,000 mg/kg	0.1 mg/L	0.5 mg/kg						
				None	None	None	None						
				None	None	None	None						
				None	None	None	None						
				None	None	None	None						
1	<u>-</u>												
Comme	ents:												
	Source wa	as Considered to be ansyv	here w/dissolved TCE ab	ove 10 parts per millio	on (1% solubility). E	stimated 272 kg TCE	mass.						
Attachmer	nts:												

Hydrogeologic Conceptual Model Facility ID#: 0364 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material <u>X</u> Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): 2 _ Unknown (assume single aquifer) X Aquifer 3 Aquifer 2 Aquifer 1 Depth to water: low value (ft bgs): 100 5 high value (ft bgs): Unknown: North (usually) Flow direction sometimes East Horizontal hydraulic gradient (feet/foot): 10^-3 to 10^-4 Unknown Vertical hydraulic gradient (feet/foot): _ Unknown K range (ft/day) Measured using: _ Slug Test Field data Laboratory low 10 ___ Unknown

Comments:

Vertical K in clay 0.0001 ft/day

K's - sand 1 - 30 ft/day, sand 2 - 0.5 ft/day, sand 3 - 0.1 ft/day, sand 4 - 5 ft/day

<u>K's - clay 1 - 0.001 ft/day, clay 2 - 1(10^-4) ft/day, clay 3 - 1(10^-4) ft/day, clay 4 - 0.002 ft/day</u>

Attachments:

The	rmal Treatment - Design					Fa	acility ID#:	0364
<u>x</u>	Thermal treatment:	Conductive						
		Electrical Resis	tance					
		3 p	hase	_ 6 phase		AC power	DC p	ower
		Steam						
		Ste		_ Steam + air		Steam + O2		
	T (T)	X Other (describe		ing with steam				
<u>x</u>	Type of Test:	_ Pilot testX	Full-scale System					
<u>x</u>	Geology of Treatment Zon		latively homogene					
		· · · · · · · · · · · · · · · · · · ·	latively homogene	•				sility motorial
			rgely permeable s rgely impermeable				-	-
		·	mpetent, but fract			-	i iligilei pelilik	sability material
			eathered bedrock,		-	illile rock)		
<u>x</u>	Treatment Targe Zone:	Saturated only			<u>x</u>	Roth (Saturate	d and Vadose z	ones)
<u>x</u>	Start of Thermal Test:	Oct-04	vaa	•	n: 4 mor		a ana vadose 2	onesy
^	_ Hydraulic Control		No	Daration	iii. <u>-i moi</u>	itiis		
	,,							
<u>x</u>	Treatment Cell Design:							
_	Size of target zone (ft2):		<u>17825</u>			Unknow	n (<u>115</u>	x <u>155</u> ft)
	Thickness of target zone (f	ft):	<u>35</u>			Unknow	n	
	Depth to top of target zone		<u>20</u>			Unknow	'n	
	Thickness of target zone b	pelow water table (ft):	<u>35</u>			Unknow	'n	
	Number of energy delivery	points:	1 per cell			Unknow	'n	
	Number of extraction point	ts:	1 per cell			Unknow	'n	
	Temperature Profile:							
	Initial formation temperature	re (deg C):					Unknown	
	Maximum representative for	ormation temperature	(deg C):				Unknown	
	Time to reach maximum re	epresentative tempera	ture (days):				Unknown	
	Duration of treatment at re	presentative temperat	ture (days):				Unknown	
				D	<u>ate</u>		Temperature	(deg C)
	Formation temperature imp	mediately post-treatme	ent:					
	Formation temperature pos	st-treatment monitorin	g event 1:					
	Duration of post-treatment	monitoring (days):						
<u>x</u>	Mass of contaminant remo					_		
		liquid pumping:				lb	kg	Unknown
		apor stream:	1225			lb	kg	Unknown
	Tota	э:	1327	2	<u>X</u>	lb	kg	Unknow
	Comments:							
	Commonto.							
	Treated .	48,000 yd3 including	n the deluge has	ed (20 to 55 ft	has) an	d 261 cells		
	Attachments:	,200 , 20 1101441110		- (=0 10 00 11				

Cost and Performance Facility ID#: 0364 Performance Remediation Goal: In Groundwater: 80% removal In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: __ In Soil Comment: General comments on the thermal application: Goal: reduce the identifiece source are mass by atleast 80% or more to meet the objective of reaching GW cleanup target levels (GCTL) Lessons Learned Energy _ kWhr/yd³ Total Energy Used: kWhr ____ kWhr/m³ _ Total energy applied to treatment zone: kWhr/m³ kWhr/yd³ __ Other energy: kWhr/m³ _ kWhr/yd³ Please note other energy: Cost 7,163,447 (includes deluge Total Project Cost: basin (\$149/yd3)) ____ Consultant Cost: __ Thermal Vendor Cost: _yd³ ___ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1:

> _ Other Cost 2: _ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	10/26/2006
	Type of treatment:	Conductive	<u>x</u>	Steam	ERH	Other:		
	Type of Contaminant:	Chlorinated Solve	ents	<u>x</u>	Petroleum Hydroc	earbons	Pesticides	
		Wood Treating			Other:			
	Treatment Status:	Active	<u>x</u>	Post				
	Type of Test:	Pilot Test	<u>x</u>	Full Scale	System			
	Start of Test:			End	of Test:		_ Duration:	
	Type of Site:	<u>x</u> Non-DOD		_DoD				
<u>x</u>	Facility Name: Gulf Powe	r / Southern Companies						
	Address:							_
	City, State, Zip Code:	Panama City, FL						
	OU# or Site #:							_
<u>×</u>	Primary point of contact:	Jay Dablow						
	Organization: <u>ERM</u>							
	Address: 3 Hutton Centre,	Suite 600						
	City, State, Zip Code:	Santa Ana, CA 92707						
	Phone #: <u>714-430-1476</u>			email: jay.o	dablow@erm.com			
<u> </u>	Other contacts or vendors wh	no worked on site			None			
	Point of contact: <u>Victor</u>	or Holstrand						
	Type:Vendor, Co	onsultant	Vend	dor, Techni	cal Applications	<u>x</u> Oth	ier	
	Organization: <u>FL EPA</u>							
	Address:							
	City, State, Zip Code:							
	Phone #: 850-595-8360 x	1212		email:				
Q.	A/QC							
	_ Characteristics of Interest							
	Good pre- and post-tree	atment groundwater data			Good pre- a	nd post-treatme	nt soil data	
	Good temperature prof	-			Flux assessr	•		
	Groundwater elevation				Geologic cr			
	Hydraulic Conductivity	v information						

0365

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0365</u>
Impacted		v direction)(ft.):		Thick	ness (ft):		Unknown
	Alternative meth		pacted zone (See source zo	ne definition attachmer	nts)		
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy			5		None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
Types of C	Contaminants						
				Average Pre-treatme	ent Concentration per	Average Post-treatme	ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
	<u> </u>					-	
Comme	ents:						
Attachmer	nts:						

drogeologic Concep	tuai wouei		
Geology:	Zone	Unconsolidated Sediments	
	Vadose Zone	e: Relatively homogeneous and permeable unconsolid	ated sediments
		Relatively homogeneous and impermeable unconso	lidated sediments
		<u>x</u> Largely permeable sediments with inter-bedded lens	ses of lower permeability material
		Largely impermeable sediments with inter-bedded la	ayers of higher permeability mater
		Competent, but fractured bedrock (i.e. crystalline roo	ck)
		Weathered bedrock, limestone, sandstone	
	Saturated Zo	ne: Relatively homogeneous and permeable unconsolid	ated sediments
		Relatively homogeneous and impermeable unconso	lidated sediments
		<u>x</u> Largely permeable sediments with inter-bedded lens	ses of lower permeability material
		Largely impermeable sediments with inter-bedded la	ayers of higher permeability mater
		Competent, but fractured bedrock (i.e. crystalline roo	ck)
		Weathered bedrock, limestone, sandstone	
Aquifer Character	ristics:	wells in or adjacent to treatment zone: ft ams	
_	ristics:	No Yes (number): Aquifer 1 Aquifer 2 Aquif bgs):	Unknown (assume single aquif
_ Aquifer Character	ristics: juifer present? low value (ft l high value (ft	No Yes (number): Aquifer 1 Aquifer 2 Aquif bgs):	Unknown (assume single aquif
Aquifer Character Is more than 1 accompleted to water: Flow direction	ristics: juifer present? low value (ft l high value (ft	NoYes (number): Aquifer 1 Aquifer 2 Aquif bgs): ! bgs):	Unknown (assume single aquif
Aquifer Character Is more than 1 ac Depth to water: Flow direction Horizontal hydrau	ristics: quifer present? low value (ft l high value (ft Unknown:	NoYes (number):	Unknown (assume single aquif fer 3
Aquifer Character Is more than 1 ac Depth to water: Flow direction Horizontal hydrau	ristics: puifer present? low value (ft be high value (ft unknown: ulic gradient (feet/foot)	NoYes (number): Aquifer 1	Unknown (assume single aquif fer 3 Unknown Unknown Unknown
Aquifer Character Is more than 1 according to the property of the property	ristics: puifer present? low value (ft the high value (ft the Unknown: ulic gradient (feet/foot) Modern present?	NoYes (number): Aquifer 1	Unknown (assume single aquif fer 3
Aquifer Character Is more than 1 acc Depth to water: Flow direction Horizontal hydrau Vertical hydraulic K range (ft/day)	ristics: quifer present? low value (ft the high value (ft Unknown: llic gradient (feet/foot) gradient (feet/foot)	NoYes (number):	Unknown (assume single aquifer 3 Unknown Unknown Field data Unknown
Aquifer Character Is more than 1 according to the property of the property	ristics: quifer present? low value (ft the high value (ft the Unknown: llic gradient (feet/foot) Moderate (feet/foot) Moderate (feet/foot) Moderate (feet/foot) Moderate (feet/foot)	NoYes (number): Aquifer 1	Unknown (assume single aquifer 3 Unknown Unknown Field data Unknown Field data Unknown Field data
Aquifer Character Is more than 1 acc Depth to water: Flow direction Horizontal hydrau Vertical hydraulic K range (ft/day)	ristics: quifer present? low value (ft the high value (ft the Unknown: lic gradient (feet/foot) Month look high value (ft the the the the the the the the the th	NoYes (number):	Unknown (assume single aquifer 3 Unknown Unknown Field data Unknown

Attachments:

Thermal Treatment - Design					Facility ID#: 0365	
Thermal treatment:	Conduct	ive				
	Electrica	l Resistance				
	_	3 phase	6 phase	AC power	DC power	
	x Steam	-				
	_	Steam	Steam + air	Steam + O2		
	Other (d	escribe)				
\underline{x} Type of Test: \underline{x}	Pilot test	Full-scale	e System			
x Geology of Treatment Zone	e: _	Relatively hon	nogeneous and permeab	le unconsolidated	sediments	
	_	Relatively hon	nogeneous and imperme	able unconsolidat	ed sediments	
	<u>x</u>	Largely perme	eable sediments with inte	er-bedded lenses o	f lower permeability ma	aterial
	_	Largely imper	meable sediments with ir	nter-bedded layers	of higher permeability	material
	_	Competent, bu	ut fractured bedrock (i.e.	crystalline rock)		
	_	Weathered be	drock, limestone, sandst	tone		
Treatment Targe Zone:	Saturate	ed only	Vadose only	Both (Satura	ted and Vadose zones)	
Start of Thermal Test:			Duration:			
Hydraulic Control	Yes	No				
x Treatment Cell Design:		<u>871</u>	120			
Size of target zone (ft2):				Unkno	own (x	ft)
Thickness of target zone (f	t):			Unkno	own	
Depth to top of target zone	(ft bgs):			Unkno	own	
Thickness of target zone be	elow water tabl	e (ft):		Unkno	own	
Number of energy delivery	points:	<u>26</u>		Unkno	own	
Number of extraction points	s:	<u>4</u>		Unkno	own	
Temperature Profile:	(1 0)					
Initial formation temperatur					Unknown	
Maximum representative for	· ·				Unknown	
Time to reach maximum re	•				Unknown	
Duration of treatment at rep	oresentative tei	mperature (days):			Unknown	
			Date	<u>2</u>	Temperature (deg	<u>C)</u>
Formation temperature imn	nediately post-	treatment:				
Formation temperature pos	st-treatment mo	nitoring event 1:			-	
Duration of post-treatment	monitoring (day	ys):				
Mass of contaminant remove	und:					
	veu. iquid pumping:			lh	ka	Unknow
				lb	kg	Unknow
Tota	apor stream:					Unknow
Tota	II.			lb	kg	Unknow
Comments:						
<u></u>						
Attachments:						

Cost and Performance					Facility ID#:	<u>0365</u>
Performance						
Remediation Goal:						
_	In Groundwater: -					
_	_					
	In Soil:					
Was the Remediation	on Goal Achieved:					
_	In Groundwater					
	Comment: -					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
_						
Energy						3
Total Energy Used:			kWhr		kW	
	tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd ³
Ot	her energy:	_			_ kWhr/m ³	kWhr/yd ³
	Please	note other energy:				
Cost						
Total Project Cost:						
	onsultant Cost:					
	nermal Vendor Cost:					
	nergy Cost:			m ³	_ yd³	
	•				_ yu	
	her Cost 1:					
·	her Cost 2:					
	her Cost 3:					
Please note o	ther cost:	Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

PD ____ File Analyzed By: Date: 11/1/2006 ____Steam Type of treatment: ___ Conductive <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: _____ Type of Site: __ DoD Non-DOD Facility Name: Confidential; Tampa, FL Address: City, State, Zip Code: Tampa, FL OU# or Site #: _ Primary point of contact: Horge Rameriz Organization: Address: City, State, Zip Code: Phone #: 813-933-0697 ext 19 email: ____ Other contacts or vendors who worked on site _ None Point of contact: Dacre Bush Type: __ Vendor, Consultant _____ Vendor, Technical Applications __Other Organization: McMillian-McGee Address: City, State, Zip Code: Phone #: 805-295-9071 email: dacre.bush@mcmillan-mcgee.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0368

General Site Information

___ Hydraulic Conductivity information

General Site As	ssessment Data					Facility II	D#: <u>0368</u>
Impacted	5 ".		Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
		=	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor \	Wells: Number of relevant n	nonitoring wells with groundy			Doot to other out		None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				· · · · g · · · · · ·			
Soil Borin	gs: Number of relevant so	il borings with pre-treatment	data:				
		il borings with post-treatmen					
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Types of	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
Confine							
	-						
Attachme	nts:						
							-

Hydrogeologic Conceptual I	Model		Facility ID#: 03
Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>	
	Vadose Zone:	Relatively homogeneous and permeable unconsolidated	d sediments
		Relatively homogeneous and impermeable unconsolida	ted sediments
		Largely permeable sediments with inter-bedded lenses	of lower permeability material
		Largely impermeable sediments with inter-bedded layer	s of higher permeability material
		Competent, but fractured bedrock (i.e. crystalline rock)	
		Weathered bedrock, limestone, sandstone	
	Saturated Zone:	Relatively homogeneous and permeable unconsolidated	d sediments
		Relatively homogeneous and impermeable unconsolida	ted sediments
		Largely permeable sediments with inter-bedded lenses	of lower permeability material
		Largely impermeable sediments with inter-bedded layer	s of higher permeability material
		Competent, but fractured bedrock (i.e. crystalline rock)	
		Weathered bedrock, limestone, sandstone	
Ground surface eleva	tion based on wells in or	adjacent to treatment zone: ft amsl	Unknown
Aquifer Characteristic	s:		
Is more than 1 aquifer	present?	No Yes (number):	_ Unknown (assume single aquifer)
		Aquifer 1 Aquifer 2 Aquifer 3	\$
Depth to water:	low value (ft bgs):		
	high value (ft bgs):		
	Unknown:		
Flow direction			
Horizontal hydraulic g			Unknown
Vertical hydraulic grad	dient (feet/foot):		Unknown
W (W)			T
K range (ft/day)	Measured (using: Slug Test Laboratory	Field data
	low		Unknown
Transmissivity (ft2/day	high y): Measured (using: Slug Test Laboratory	 Field data
Transmissivity (ft2/day	low	using Slug rest Laboratory	
			Unknown
	high		
Comments:			
Comments.			
Attachments:			

The	ermal Treatment - Design							Facility ID#:	0368
<u>x</u>	Thermal treatment:		_ Conductive	e					
		<u>x</u>	Electrical l	Resistance					
				_ 3 phase		_ 6 phase	AC pov	verDC	power
			_ Steam	Steam		_ Steam + air	Steam -	- O2	
			Other (des	cribe)					
<u>x</u>	Type of Test:	_ Pilot	test	<u>x</u> Full-	scale Syste	m			
_	_ Geology of Treatment Zor	ne:	_	_ Relatively	homogen	eous and permea	able unconsolid	ated sediments	
				_ Relatively	homogen	eous and imperm	neable unconso	lidated sediments	
				_ Largely pe	ermeable s	ediments with in	ter-bedded lens	es of lower perme	ability material
			_	_ Largely im	permeable	e sediments with	inter-bedded la	yers of higher peri	meability material
			_	_ Competer	nt, but fract	ured bedrock (i.e	e. crystalline roo	ck)	
				_ Weathere	d bedrock,	limestone, sand	stone		
	_ Treatment Targe Zone:		_ Saturated	only	Vac	lose only		aturated and Vadose	
	_ Start of Thermal Test:					Duration	:		
	_ Hydraulic Control		_ Yes	No					
	_ Treatment Cell Design:								
	Size of target zone (ft2):						U	nknown (_ x ft)
	Thickness of target zone (ft):						nknown	
	Depth to top of target zone		s):				<u> </u>	nknown	
	Thickness of target zone b			(ft):			u	Inknown	
	Number of energy delivery	/ point	s:				U	Inknown	
	Number of extraction poin	ts:					U	nknown	
	_ Temperature Profile:								
	Initial formation temperatu	re (de	g C):					Unknow	1
	Maximum representative f	ormati	on tempera	ture (deg C):			Unknown	1
	Time to reach maximum re	eprese	ntative tem	perature (da	ays):			Unknown	1
	Duration of treatment at re	prese	ntative temp	perature (da	ys):			Unknown	1
									(1. 0)
	Formation to manage time in					<u>Da</u>	<u>te</u>	Temperatu	re (deg C)
	Formation temperature im				. 4.				
	Formation temperature po			ū	11:			-	
	Duration of post-treatment	HIOHII	oning (days).					
	_ Mass of contaminant remo	oved:							
	_		pumping:				lb	kg	Unknow
		-	tream:				lb	kg	Unknow
	Tot						lb	kg	Unknow
	Comments:								
	Attachments:								

and Performance					Facility ID#:	0368
_ Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_	·					
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
_ Energy						
Total Energy Used:			kWhr	k\Mhr/m³	k1	Mbr/vd ³
	· · · · · · · · · · · · · · · · · · ·	rootmont zono:	KWIII		kWhr/m³	wiii/yu kWhr/yd
	tal energy applied to t	realment zone:				
Oth	ner energy:				_ kWhr/m ³	kWhr/yd
	Please	note other energy:	-			
Cost						
Total Project Cost:						
-	nsultant Cost:					
	ermal Vendor Cost:					
				_m³	_ yd³	
	ergy Cost:				_ yu	
	ner Cost 1:					
	her Cost 2:					
	ner Cost 3:	-				
Please note of	ther cost:	Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD							Date:		10/11/2006
	Type of treatment:	Conductive		_ Steam	<u>x</u>	ERI	- I	Other:			
	Type of Contaminant:	Chlorinated Solv	ents	<u>x</u>	Petr	oleum	Hydrocar	bons	Po	esticides	
		Wood Treating		<u>x</u>	Oth	er:	kerosen	e like specialt	y fuel		
	Treatment Status:	Active	<u>x</u>	Post							
	Type of Test:	Pilot Test	<u>x</u>	Full Scale	Syste	m					
	Start of Test:	5/27/1999		End	of Tes	t: <u>12/1</u>	0/1999		Durati	ion: <u>198 d</u>	ays
	Type of Site:	<u>x</u> Non-DOD		_DoD							
<u>x</u>	Facility Name: Confidenti	al Manufacturing Plant									
	Address: <u>Doraville</u>										
	City, State, Zip Code:	<u>GA</u>									
	OU# or Site #:										_
<u>x</u>	Primary point of contact:	Trish Reifenberger									
^	Organization: Brown and	_									
	Address: 990 Hammond D										
	City, State, Zip Code:	Atlanta, GA 30328									
	Phone #: <u>770-673-3630</u>			email: trei	fenberg	ger@b	rncald.cor	<u>n</u>			
<u>x</u>	Other contacts or vendors wh	o worked on site				_ Non	ie				
	Point of contact: <u>Greg</u>	g Beyke (White paper)									
	Type: <u>x</u> Vendor, Co	onsultant	_Ven	dor, Techni	cal Ap	plicati	ons	Otl	ner _		_
	Organization: <u>TRS</u>										
	Address: 4137 Jensome La	ane,									
	City, State, Zip Code:	Franklin, TN									
	Phone #: <u>615-791-5772</u>			email: gbe	yke@t	herma	lrs.com				
Q	A/QC										
	_ Characteristics of Interest										
	Good pre- and post-trea	atment groundwater data				_Goo	d pre- and	post-treatme	nt soil data	ı	
	Good temperature prof	ile vs. time information			_	_ Flux	assessme	nt			
	Groundwater elevation	.s				_ Geo	logic cros	s-section			
	Hydraulic Conductivity	y information									

0370

General Site Information

x Impacted .	Impacted zone	as defined by documentation nod for determining size of im	Width (ft): pacted zone (See source z		ness (ft): <u>10</u>		Unknown					
Monitor W		monitoring wells with groundw tive to treatment zone: In:	vater data: Pre-treatment Upgradient:	::	Post-treatment:	ssgradient:	None					
		Post-treatment In: Upgradient: Downgradient: Crossgradient: Crossg										
Soil Boring		oil borings with pre-treatment oil borings with post-treatmen eent zone:	t data:	de treatment zone:								
					ent Concentration per		ent Concentration per					
	Oblania et al Calanata	Detectors Hedereckers	Other	Chen Groundwater (mg/L)	nical: Soil (mg/kg)	Cher Groundwater (mg/L)	nical: Soil (mg/kg)					
	Chlorinated Solvents Trichloroethene	Petroleum Hydrocarbons Hexane	Creosote	None None	None	None None	None					
	Tetrachloroethene	Jet Fuel	x specialty fuel	None	None	None	None					
	1,1-dichloroethene	Napthalene	x specialty fuel	None	None	None	None					
	cis-1,2-dichloroethene	Benzene		None	None	None	None					
	trans-1,2-dichloroethene	Tolune		None	None							
	1,1-dichloroethane					None	None					
	1,1-dichloroethane	Ethylbenzene		None	None	None	None					
		m/p-xylene										
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None					
Concern	1,1,2-trichloroethane			None	None	None	None					
	1,1,2,2-tetrachloroethane			None	None	None	None					
	Vinyl Chloride			None	None	None	None					
				None	None	None	None					
	-			None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
Comme			· ·	s 4,900 ft2 up to a 10 ft iscosity of 2 mm2/s St		The specialty fuel ha	s a boiling point of					
Attachmen	ts:											
	-											

0370

General Site Assessment Data

Hydrogeologic Conceptual Model Facility ID#: 0370 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Unknown 1050 ft amsl Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): 23 high value (ft bgs): 27 Unknown: Flow direction no significant flow Horizontal hydraulic gradient (feet/foot): < 0.01 Unknown Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: _ Slug Test Field data Laboratory low Unknown high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory Field data

Attachments:

Attachments:

Unknown

low

high

Comments:

The	rmal Treatment - Design											Faci	lity ID#:	037	<u>70</u>
<u>x</u>	Thermal treatment:		_ Condu	ıctive											
		<u>x</u>	Electr	ical Resi	istance										
				<u>x</u> 3	phase		6 pha	se		AC po	wer		D	C powe	r
			_ Steam	_											
				Si	team		Steam	ı + air		Steam	+ O2				
			_ Other	(describ	e)										
<u>x</u>	Type of Test:	_ Pilot	test	<u>x</u>		-scale S	•								
<u>X</u>	Geology of Treatment Zone	e:			•		geneous an	•							
				_	•		geneous an	•							
							ole sedimen						-	-	
							eable sedim					s of h	iigher pei	rmeabi	lity material
					•		fractured be		-	lline ro	ock)				
.,	Treatment Torre Zone		Catur				ock, limesto			D.d.	C		. 137. 1		`
<u>X</u>	Treatment Targe Zone: Start of Thermal Test:		_ Satur /1999	ated on	iiy		Vadose only	Duration:			Satura	ateu a	ind Vados	e zones)
<u>x</u>	Hydraulic Control	<u>3/2//</u>	Yes		No			Duration.	196 U	ays					
<u>x</u>	Trydraulic Control	^	103	_	110										
<u>x</u>	Treatment Cell Design:														
_	Size of target zone (ft2):					4900					Unkn	own	(_	x	ft)
	Thickness of target zone (fi	t):				<u>10</u>					Unkne	own			
	Depth to top of target zone	(ft bg	s):			<u>20</u>					Unkn	own			
	Thickness of target zone be	elow v	vater ta	able (ft):		<u>6</u>					Unkne	own			
	Number of energy delivery	points	s:			<u>50</u>					Unkn	own			
	Number of extraction points	s:				<u>50</u>					Unkne	own			
<u>x</u>	Temperature Profile:														
_	Initial formation temperatur	e (de	g C):									<u>x</u>	Unknow	'n	
	Maximum representative for	rmati	on tem	peratur	e (deg C):						<u>x</u>	Unknow	'n	
	Time to reach maximum re	prese	ntative	temper	ature (d	ays):						<u>x</u>	Unknow	'n	
	Duration of treatment at rep	oresei	ntative	tempera	ature (da	ays):						<u>x</u>	Unknow	'n	
												_			0)
	Formation temperature imn	nedia	tely pos	st-treatr	nent:			Date	<u>e</u>			1	emperat	ure (de	<u>g C)</u>
	Formation temperature pos					t 1:									
	Duration of post-treatment				Ū										
<u>x</u>	Mass of contaminant remove	ved:													
_	Via I	iquid	pumpin	ıg:						lb			_ kg		Unknown
	In va	apor s	tream:							lb			_kg		Unknown
	Tota	ıl:											_ kg	<u>x</u>	Unknown
	Comments:														
	Attachments:														

t and Performance		Facility ID#:	<u>0370</u>
Performance			
Remediation Goal:			
<u>x</u>	In Groundwater	:	
		To reduce LNAPL thickness to less than 1/8 inch	
<u>x</u>	In Soil:		
		To reduce LNAPL thickness to less than 1/8 inch	
Was the Remediat	ion Goal Achieved:		
<u>x</u>	In Groundwater		
	Comment	:	
		Yes, LNAPL was reduced	
<u>x</u>	In Soil		
	Comment	:	
		Yes, LNAPL was reduced	
Conoral comments	s on the thermal app	lication	
General comments	s on the thermal app	nication:	
	ation wells of extrac	ction/monitoring and ERH	
electrode		Goal was only to reduce LNAPL thic	<u>knes</u> s
Lessons Learned			
	:	kWhrkWhr/m ³ kWhr/	/yd³
_ Energy Total Energy Used	: otal energy applied		/yd³ kWhr/yd³
_ Energy Total Energy Used		to treatment zone:kWhr/m³	kWhr/yd ³
_ Energy Total Energy Used	otal energy applied ther energy:	to treatment zone:kWhr/m³	
_ Energy Total Energy Used To	otal energy applied ther energy:	to treatment zone:kWhr/m³kWhr/m³	kWhr/yd ³
_ Energy Total Energy UsedTO	otal energy applied ther energy: Plea	to treatment zone:kWhr/m³kWhr/m³	kWhr/yd ³
_ Energy Total Energy UsedTOCost Total Project Cost:	otal energy applied ther energy: Plea	to treatment zone:kWhr/m³kWhr/m³	kWhr/yd ³
Energy Total Energy UsedTOCost Total Project Cost:C	otal energy applied ther energy: Plea	to treatment zone: kWhr/m³ kWhr/m³ see note other energy:	kWhr/yd ³
_ Energy Total Energy UsedTOCost Total Project Cost:C	otal energy applied ther energy: Plea onsultant Cost: hermal Vendor Cost	to treatment zone: kWhr/m³kWhr/m³ see note other energy:	kWhr/yd ³
_ Energy Total Energy UsedTCCost Total Project Cost:C	otal energy applied ther energy: Plea onsultant Cost: hermal Vendor Cost nergy Cost:	to treatment zone: kWhr/m³ kWhr/m³ see note other energy:	kWhr/yd ³
Energy Total Energy UsedTOCost Total Project Cost:CTEO	otal energy applied ther energy: Please onsultant Cost: hermal Vendor Cost nergy Cost: ther Cost 1:	to treatment zone: kWhr/m³kWhr/m³ see note other energy:	kWhr/yd ³
Energy Total Energy UsedTOCost Total Project Cost:CTEO	otal energy applied ther energy: Plea onsultant Cost: hermal Vendor Cost nergy Cost:	to treatment zone: kWhr/m³kWhr/m³ see note other energy:	kWhr/yd ³
_ Energy Total Energy UsedT OCost Total Project Cost: C T E O	otal energy applied ther energy: Please onsultant Cost: hermal Vendor Cost nergy Cost: ther Cost 1:	to treatment zone: kWhr/m³kWhr/m³ see note other energy:	kWhr/yd ³

____ Other Cost 3:

x File Analyzed By:	JT <u>x</u> PI					Date:	10/30/2006
Type of treatment:	Co	onductive	Steam	<u>x</u> ERH	Other:		
Type of Contaminant:	<u>x</u> CI	nlorinated Sol	lvents	Petroleum Hydro	carbons	Pesticide	s
	w	ood Treating		Other:			
Treatment Status:	<u>x</u> A	ctive	Post				
Type of Test:	Pi	lot Test	Full So	ale System			
Start of Test:	<u>2006</u>		Е	nd of Test:		_ Duration:	
Type of Site:	<u>x</u> No	on-DOD	DoD				
x Facility Name: <u>Carter</u>	sville, GA						
Address:							
City, State, Zip Code:	Cartersy	ille, GA					
OU# or Site #:							
Primary point of contact	David F	leming					
Organization: <u>TRS</u>							
Address: 7421-A War	ren SE						
City, State, Zip Code:	Snoqual	mie, WA 980	<u>165</u>				
Phone #: 425-396-426	<u>66</u>		email: g	Ifleming@thermalrs.com			
Other contacts or vendor	s who worked	on site		None			
Point of contact:	Dave Smoak						
Type:Vendo	r, Consultant		Vendor, Tec	nnical Applications	Oth	ner	
Organization: <u>Macte</u>	<u>c</u>						
Address:							
City, State, Zip Code:							
Phone #: <u>770-421-340</u>	00		email:	lesmoak@mactec.com			
QA/QC							
Characteristics of Inte	est						
Good pre- and pos	t-treatment gr	oundwater dat	ta	Good pre- a	and post-treatme	ent soil data	
Good temperature	profile vs. tim	e information	1	Flux assess	ment		
Groundwater eleva	ntions			Geologic cr	oss-section		
Hydraulic Conduc	tivity informat	tion					

0373

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0373</u>
Impacted	- "	w direction)(ft.):		Thic	kness (ft):	_	Unknown
		•		una dafinitian attachma	nto)		
		nod for determining size of im	npacted zone (See source zo	one definition attachme	ints)		
	Map attachment	l .					
Monitor V	Vells: Number of relevant n	nonitoring wells with grounds	water data: Pre-treatment:		Post-treatment:		None
	Number of wells related	tive to treatment zone:	Fie-treatment.		rost-treatment.		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				g		g <u></u>	
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:				
		oil borings with post-treatmer					
	Number inside treatm	- '		treatment zone:			
			_	_			
Types of C	Contaminants						
					nent Concentration per mical:	Average Post-treatme	ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
Concern	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
	x methylene chloride			1,000 mg/L	1,000 mg/kg	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
					1		
Comments:							
	-						
Attachmer	nts:						
	-						

Hyd	rogeologic Conceptual	Model		Facility ID#: 0373
	_Geology:	Zone Vadose Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidate Relatively homogeneous and impermeable unconsolid	ated sediments
		Saturated Zone:	Largely permeable sediments with inter-bedded lenses Largely impermeable sediments with inter-bedded laye Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidate Relatively homogeneous and impermeable unconsolid Largely permeable sediments with inter-bedded lenses Largely impermeable sediments with inter-bedded laye Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ers of higher permeability material ed sediments ated sediments of lower permeability material ers of higher permeability material
	_ Ground surface eleva	ation based on wells in o	adjacent to treatment zone: ft amsl	Unknown
<u>X</u>	Aquifer Characteristic		N. V. (a. b.)	H. I
	Is more than 1 aquife Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	No Yes (number): Aquifer 1 Aquifer 2 Aquifer 15	
	_ Flow direction			
	_ Horizontal hydraulic gra			Unknown
	_ K range (ft/day)	Measured low high	using: Slug Test Laboratory	Field data
	Transmissivity (ft2/da	•	using: Slug Test Laboratory	Field data
	Comments:			
	Attachments:			

The	ermal Treatment - Design						Facility ID#:	0373
<u>x</u>	Thermal treatment:		Conductive					
		<u>x</u>	Electrical Resistance	ce				
			3 phase	e	6 phase	AC power	DC	power
			Steam					
			Steam		Steam + air	Steam + O	2	
			Other (describe)					
_	Type of Test:	_ Pilot to		Full-scale System				
<u>X</u>	Geology of Treatment Zon	ie:	<u> </u>	-	ous and permeat			
				-	ous and imperme			shility motorial
			_		ediments with inte		•	neability material
					red bedrock (i.e.	•	is of fligher pen	neability material
					imestone, sands			
	_ Treatment Targe Zone:		Saturated only	Vado		Both (Satu	rated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	2006	Cataratoa omy		•	Both (butt		
2	_ Hydraulic Control		Yes1	No	24.4.10			
	_ ,							
<u>x</u>	Treatment Cell Design:							
	Size of target zone (ft2):			12130		Unk	nown (_ x ft)
	Thickness of target zone (ft):		<u>25</u>		Unk	nown	
	Depth to top of target zone	e (ft bgs)):	<u>5</u>		Unk	nown	
	Thickness of target zone b	elow wa	ater table (ft):	<u>15</u>		Unk	nown	
	Number of energy delivery	points:		<u>56</u>		Unk	nown	
	Number of extraction point	ts:		<u>56</u>		Unk	nown	
	_ Temperature Profile:							
	Initial formation temperatu	re (deg	C):				Unknown	
	Maximum representative f	ormatio	n temperature (de	eg C):			Unknown	
	Time to reach maximum re	epresen	tative temperature	e (days):	-		Unknown	
	Duration of treatment at re	present	ative temperature	e (days):			Unknown	
					Date	<u>e</u>	Temperatu	re (deg C)
	Formation temperature im							
	Formation temperature po		_	event 1:				
	Duration of post-treatment	monito	ring (days):					
	_ Mass of contaminant remo	oved:						
	Via	liquid p	umping:			lb	kg	Unknown
	In v	apor str	eam:			lb	kg	Unknown
	Tot	al:				lb	kg	Unknown
	Comments:							_
	Attachments:							

Cost and Performance Facility ID#: 0373 Performance Remediation Goal: _ In Groundwater: -__ In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: ___ In Soil Comment: General comments on the thermal application: Lessons Learned Energy __ kWhr/yd³ ____ kWhr/m³ Total Energy Used: ____ kWhr _kWhr/yd³ kWhr/m³ _ Total energy applied to treatment zone: _ kWhr/m³ _ kWhr/yd³ ___ Other energy: Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ___ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1: Other Cost 2:

Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD	_			Date:	10/30/2006
	Type of treatment:	Conductive	Steam	<u>x</u> ERH	Other:		
	Type of Contaminant:	X Chlorinated Sol		Petroleum Hydroc	arbons	Pesticide	S
	Treatment Status:	Wood Treating <u>x</u> Active	Post	Other:			
	Type of Test:	Pilot Test	Full Sca	le System			
	Start of Test:	2006		d of Test:		_ Duration:	
	Type of Site:	Non-DOD	DoD				
<u>x</u>	Facility Name: Siemens E	Energy and Automation	<u>Facility</u>				
	Address: 2037 Wee	ems Road					
	City, State, Zip Code:	Tucker, GA					
	OU# or Site #:						
<u>x</u>	Primary point of contact:	David Fleming					
	Organization: <u>TRS</u>						
	Address: 7421-A Warren	<u>SE</u>					
	City, State, Zip Code:	Snoqualmie, WA 980	<u>065</u>				
	Phone #: <u>425-396-4266</u>		email: <u>df</u>	leming@thermalrs.com			
<u>x</u>	Other contacts or vendors when	ho worked on site		None			
	Point of contact: Kev	vin Sweeney					
	Type:Vendor, C	Consultant	Vendor, Tech	nical Applications	Oth	er	
	Organization:						
	Address:						
	City, State, Zip Code:						
	Phone #: <u>770-751-2346</u>		email: <u>ke</u>	evin.sweeney@siemens	s.com		
Q	A/QC						
	Characteristics of Interest	t					
	Good pre- and post-tre		ta	Good pre- a	nd post-treatmen	nt soil data	
	Good temperature prof	-		Flux assessn	-		
	Groundwater elevation			Geologic cro			
	Hydraulic Conductivit			-			

0375

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0375</u>
Impacted	.		Width (ft):	Thick	ness (ft):		Unknown
	 •	s defined by documentation					
	<u> </u>	od for determining size of im	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor V	Vells: Number of relevant m	onitoring wells with groundy					None
	Number of wells relati	ve to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	no: Number of relevant con	il borings with pre-treatment	data				
3011 B011110		il borings with post-treatmen					
	Number inside treatme			treatment zone:			
	rumber maide treatme		_ rumber outside				
Types of C	Contaminants						
				Average Pre-treatme	ent Concentration per	Average Post-treatm Chen	ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	None	1 mg/kg	None	None
	x Tetrachloroethene	Jet Fuel		None	10 mg/kg	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Observiceds of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	<u>x</u> Vinyl Chloride			None	5 mg/kg	None	None
	x methylene chloride			None	100 mg/kg	None	None
	x <u>DCE</u>			None	5 mg/kg	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
		<u> </u>		None	None	None	None
_							
Comments:							
Attachmer	nts:	·	<u> </u>	<u> </u>	<u> </u>	·	

Facility ID#: Hydrogeologic Conceptual Model 0375 Geology: Zone Unconsolidated Sediments ____ Relatively homogeneous and permeable unconsolidated sediments Vadose Zone: ____ Relatively homogeneous and impermeable unconsolidated sediments __ Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock)

								.,,		
				W	eathered bed	rock, limesto	one, sandsto	ne		
		Saturated	Zone:	Re	latively home	ogeneous ar	nd permeable	e unconsolidated	sediments	
				Re	latively home	ogeneous ar	nd impermea	ble unconsolidate	ed sediments	
				La	rgely permea	ıble sedimer	nts with inter-	bedded lenses of	lower permeabi	lity material
				La	rgely imperm	eable sedim	ents with int	er-bedded layers	of higher permea	ability material
								rystalline rock)		•
					eathered bed		•	•		
					odinorod boo	rook, iirriook	orio, oariaoto	110		
	_ Ground surface ele	evation based	on wells in o	or adjacen	t to treatmen	t zone:		ft amsl	_	Unknown
<u>x</u>	Aquifer Characteris	stics:								
	Is more than 1 aqu	ifer present?		No	Y	es (number):			Unknown (assume	e single aquifer)
				Aqu	ifer 1	Aqı	uifer 2	Aquifer 3		
	Depth to water:	low value	(ft bgs):	<u>20</u>			_			
		high value	e (ft bgs):						_	
		Unknown	:						_	
	_ Flow direction									
	_ Horizontal hydrauli	-					 -			Unknown
	Vertical hydraulic g	gradient (feet/f	oot):							Unknown
	_ K range (ft/day)		Measured	usina:	Slu	a Test	Labor	atory	Field data	
	_ rerange (ready)		low	doing.		, 1001		utory	r icid data	Unknown
			high							_ Chikhown
	Transmissivity (ft2/	(day):	Measured	ueina:	Slu	Test	Labor	atory	— Field data	
	Transmissivity (ItZ/	uay).	low	using.		y 163t		•		Unknown
										_ Unknown
			high							
	_									
	Comments: _									
	_									
	=									
	Attachments:									
	_									

The	rmal Treatment - Design						Facility ID#:	<u>0375</u>
<u>x</u>	Thermal treatment:		_ Conductive					
		<u>x</u>	Electrical Resist	tance _				
			3 pl	hase	6 phase	AC pow	er DO	power
			_ Steam					
			Stea	am	Steam + air	Steam +	O2	
			Other (describe)					
	_ Type of Test:	Pilot		Full-scal	-			
	_ Geology of Treatment 2	Zone:	<u> </u>	-	mogeneous and per			
				-	mogeneous and imp			
					eable sediments with		·	-
					rmeable sediments v			meability material
			<u> </u>	-	out fractured bedrock		()	
	T		<u> </u>		edrock, limestone, sa		1 177 1	
<u>X</u>	Treatment Targe Zone:		_ Saturated only	<u>x</u>	•		turated and Vadose	
<u>X</u>	Start of Thermal Test:	2006	=		Dura	tion:		
	_ Hydraulic Control		Yes	No				
<u>x</u>	Treatment Cell Design:							
^	Size of target zone (ft2)			16	6357	Ur	nknown (_ x ft)
	Thickness of target zon			20		Ur		_ ^ 10)
	Depth to top of target zo		ıs):	0	=	Ur		
	Thickness of target zon			0		Ur		
	Number of energy deliv			65		Ur		
	Number of extraction po			65		Ur		
	_ Temperature Profile:		0)					
	Initial formation tempera			(de e C).			Unknow	
	Maximum representativ		•				Unknow	
	Time to reach maximum	•	•				Unknow	
	Duration of treatment at	represei	ntative temperat	ure (days)	·		Unknow	n
						Date	Temperatu	ıre (deg C)
	Formation temperature	immedia	tely post-treatme	ent:				
	Formation temperature	post-trea	tment monitoring	g event 1:				
	Duration of post-treatme	-		-				
	Manage of a contaminate of the							
	_ Mass of contaminant re						,	** 1
			pumping:			lb	kg	Unknown
		n vapor s	tream:			lb	kg	Unknown
	'	Γotal:				lb	kg	Unknown
	Comments:							
	<u>17</u> foo	ot electro	ode spacing					
	Attachments:							

Cost and Performance Facility ID#: 0375

<u>x</u>

Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
<u>x</u>	In Soil:					
		methylene Chloride - 0	.08; PCE - 0.08;	TCE - 0.13; DC	E - 0.53; VC -	0.04 mg/kg
Was the Remediation	Goal Achieved					
	Comment: —					
	_					
	 In Soil					
	Comment: —					
	_					
General comments or	n the thermal applica	ation:				
-						
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³		Vhr/yd ³
Tota	I energy applied to to	reatment zone:			_ kWhr/m ³	kWhr/yd ³
Othe	er energy:	_			_ kWhr/m ³	kWhr/yd ³
	Please	note other energy:				
Cost						
Total Project Cost:						
-	sultant Cost:					
	mal Vendor Cost:					
· · · · · · · · · · · · · · · · · · ·	rgy Cost:			_ m ³	_ yd³	
	er Cost 1:			_'''	_ yu	
· · · · · · · · · · · · · · · · · · ·						
	er Cost 2:					
	er Cost 3:	Other Cost 1:				
Please note oth	er cost:	Other Cost 1:				
		Other Cost 2:				
		Other Cost 3:				

File Analyzed By: Date: PD ____ 11/9/2006 Type of treatment: ___ Conductive Steam ____Other: Type of Contaminant: _ Chlorinated Solvents Petroleum Hydrocarbons Pesticides <u>X</u> ___ Wood Treating Other: **PAHs** <u>X</u> Treatment Status: ____ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: 4/5/2002 End of Test: 8/5/2002 Duration: 120 d Type of Site: DoD Non-DOD <u>X</u> Facility Name: Hunter Army Airfield, GA Address: City, State, Zip Code: Savannah, GA OU# or Site #: Former Pumphouse #2 Primary point of contact: Ana Vergara Organization: US Army Coprs of Engineerins (USACE) Address: 100 West Oglethorpe Avenue City, State, Zip Code: Savannah, GA 1401 Phone #: 912-652-5835 email: ana.vergara@us.army.mil Other contacts or vendors who worked on site _None Point of contact: Patty Stoll Type: Vendor, Consultant __ Vendor, Technical Applications __Other Organization: Science Applications International Corporation Address: 151 Lafayette Drive, PO Box 2501 City, State, Zip Code: Oak Ridge, TN 37831 Phone #: 865-481-4600 email: QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data __ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _Geologic cross-section

Facility ID#:

0380

General Site Information

___ Hydraulic Conductivity information

	General Site Ass	sessment Data					Facility II	D#: <u>0380</u>			
	x Impacted 2	0 "	w direction)(ft.): <u>below</u> as defined by documentation	Width (ft):	Thick	ness (ft):		Unknown			
				npacted zone (See source zo	ne definition attachmer	nte)					
		Map attachment	=	ipacieu zone (See Source 20	ne delimilion allacime	its)					
		wap attacriment	•								
	<u>x</u> Monitor W	falls: Number of relevant n	nonitoring wells with ground	water data:				None			
	<u>x</u> INIOTHIOT VI	elis. Number of relevant i	normorning wens with ground	Pre-treatment:	12	Post-treatment:	12	None			
		Number of wells relat	tive to treatment zone:	Fie-treatment.	12	rost-treatment.	12				
		Pre-treatment	In: 12	Upgradient:	Downgradient:	Cro	ssgradient:				
		Post-treatment	In: 12	Upgradient:	Downgradient:		ssgradient:				
		rost-treatment	III. <u>12</u>	opgradient.	Downgradient.		ssgraulerit.				
	x Soil Boring	e: Number of relevant so	oil borings with pre-treatmen	t data:							
	<u>x</u> Oon Doning		oil borings with post-treatmen								
		Number inside treatm		Number outside	treatment zone:	<u>3</u>					
		Number inside treatin	ent 20ne. <u>1</u>	Number outside	treatment zone.	2					
	v Types of C	ontaminants									
	x Types of C	ontaminants						_			
						ent Concentration per		ent Concentration per			
		CIL : 101	D. 1 W. 1	Other	Cher Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	mical: Soil (mg/kg)			
ſ		Chlorinated Solvents	Petroleum Hydrocarbons			, , ,	, ,	, , ,			
		Trichloroethene	Hexane Let Food	Creosote	None	None	None	None			
		Tetrachloroethene	Jet Fuel	x <u>acenaphthene</u>	None	None	0.001 mg/L	0.5 mg/kg			
		1,1-dichloroethene	Napthalene	x anthracene	None	None	0.001 mg/L	0.5 mg/kg			
		cis-1,2-dichloroethene	x Benzene		0.5 mg/L	None	0.1 mg/L	0.05 mg/kg			
		trans-1,2-dichloroethene	x Tolune		1 mg/L	None	0.05 mg/L	0.01 mg/kg			
		1,1-dichloroethane	<u>x</u> Ethylbenzene		1 mg/L	None	0.1 mg/L	0.01 mg/kg			
		1,2-dichloroethane	m/p-xylene	x 2-methynaphthalene	None	None	0.005 mg/L	None			
	Chemicals of	1,1,1-trichloroethane	o-xylene	x benzo(a)anthracene	None	None	None	0.5 mg/kg			
	Concern	1,1,2-trichloroethane	x xylenes		5 mg/L	None	0.1 mg/L	0.01 mg/kg			
		1,1,2,2-tetrachloroethane		x benzo(a)pyrene	None	None	None	0.5 mg/kg			
		Vinyl Chloride		x benzo(b)fluoranthene	None	None	None	0.5 mg/kg			
				x benzo(g,h,i)perylene	None	None	None	0.1 mg/kg			
				x chrysene	None	None	None	0.1 mg/kg			
				x Fluoranthene	None	None	0.01 mg/L	0.1 mg/kg			
				x Fluorene	None	None	0.001 mg/L	0.1 mg/kg			
				x Indeno(1,2,3-cd)pyrene	None	None	None	0.1 mg/kg			
L				x <u>naphthalene</u>	None	None	0.05 mg/L	0.1 mg/kg			
	Commer	nte:									
	Comme	ito.									
		Benzene impacted area of 55,000ft2 (above 5 mg/L) in January 2002. After treatment it was 12,500 ft2 in July of 2005. Soil concentrations (mg/kg) for ethylbenzene was 0.005 and for benzene, toluene, and xylenes it was 0.001									
			Con concentrations (IIIq/	ng, for entyperizerie was t	and for benzer	o, toluelle, allu xylel	103 IL WAS U.UU I				
	Attachmen	<u> </u>									
	Auachmen										
								_			

x Impacted	Zone: Length (parallel to flow	v direction)(ft.): <u>below</u>	Width (ft):	Thick	ness (ft):		Unknown				
	Impacted zone a	as defined by documentation	ı								
	Alternative method	od for determining size of im	npacted zone (See source z	one definition attachmen	nts)						
	Map attachment										
<u>x</u> Monitor W	Vells: Number of relevant m	Number of relevant monitoring wells with groundwater data:									
			Pre-treatment	: <u>12</u>	Post-treatment:	<u>12</u>					
	Number of wells relat	ive to treatment zone:									
	Pre-treatment	In: <u>12</u>	Upgradient:	Downgradient:	Cro	ssgradient:					
	Post-treatment	ln: <u>12</u>	Upgradient:	Downgradient:	Cro	ssgradient:					
x Soil Boring	gs: Number of relevant so	il borings with pre-treatment	t data:								
	Number of relevant so	umber of relevant soil borings with post-treatment data: 4									
Number inside treatment zone: $\underline{1}$ Number outside treatment zone: $\underline{3}$											
x Types of C	Contaminants	T	1			1					
				Average Pre-treatme	ent Concentration per	Average Post-treatm	nent Concentration per				
				Chen			mical:				
h	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	Trichloroethene	Hexane	Creosote	None	None	None	None				
	Tetrachloroethene	Jet Fuel	x phenanthrene	None	None	0.01 mg/L	1 mg/kg				
	1,1-dichloroethene	Napthalene	x pyrene	None	None	0.005 mg/L	1 mg/kg				
	cis-1,2-dichloroethene	Benzene		None	None	None	None				
	trans-1,2-dichloroethene	Tolune		None	None	None	None				
	1,1-dichloroethane	Ethylbenzene		None	None	None	None				
	1,2-dichloroethane	m/p-xylene		None	None	None	None				
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None				
Concern	1,1,2-trichloroethane	xylenes		None	None	None	None				
	1,1,2,2-tetrachloroethane			None	None	None	None				
	Vinyl Chloride			None	None	None	None				
				None	None	None	None				
			<u> </u>	None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
Comme	nts:										
Attachmen	nts:										
	-										

0380

General Site Assessment Data

Hydrogeologic Conceptual Model Facility ID#: 0380 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments _ Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): $\underline{2}$ _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): 12 high value (ft bgs): 16 Unknown: Flow direction SWHorizontal hydraulic gradient (feet/foot): 0.0072 (ave) __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown K range (ft/day) Measured using: _ Slug Test Field data Laboratory low Unknown 34.3 high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory _ Field data low Unknown high

Attachments:

Horizontal hydraulic gradient baried from 0.0026 to 0.0091.

K=0.0121 cm/sec

Comments:

Ther	mal Treatment - Design								Facility ID#:	0380	
<u>x</u>	Thermal treatment:		Conductiv	е							
		<u>x</u>	Electrical	Resistance							
			Steam	_ 3 phase		_ 6 phase		_ AC power	DC	power	
				_ Steam		_ Steam + air	_	_ Steam + C)2		
			Other (des	cribe)							
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Full-	scale Syster	m					
<u>x</u>	Geology of Treatment Zone	:	<u>x</u>	•	•	eous and perm			ed sediments ated sediments		
				-	_	•			s of lower permea	hility material	
									•	•	
					rgely impermeable sediments with inter-bedded layers of higher permeability material impetent, but fractured bedrock (i.e. crystalline rock)						
				_		limestone, sai		amine rock)			
<u>x</u>	Treatment Targe Zone:		Saturated			lose only		Roth (Sati	urated and Vadose	zonec)	
<u>x</u>	Start of Thermal Test:	4/5/2	='	Conly	vao	•	on: 120		irated and vadose	zones)	
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No		Duran	OII. <u>120</u>	<u>u</u>			
^	Trydraulio Control	^	103								
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):				30000			Unk	cnown (x ft)	
	Thickness of target zone (ft):			<u>8</u>			Unk	cnown		
	Depth to top of target zone	(ft bgs	s):		<u>8</u>			Unk	cnown		
	Thickness of target zone be	low w	ater table	(ft):	<u>4</u>			Unk	cnown		
	Number of energy delivery	points	::		<u>111</u>			Unk	cnown		
	Number of extraction points	i:			<u>41</u>			Unk	cnown		
<u>x</u>	Temperature Profile:		0)			20					
	Initial formation temperature			(de e. O	.	<u>20</u>			Unknown		
	Maximum representative fo		•			<u>90</u>			Unknown		
	Time to reach maximum representative temperature (d.			,	<u>110</u>			Unknown			
	Duration of treatment at rep	resen	itative tem	perature (da	iys):	<u>10</u>			Unknown		
						<u>1</u>	<u>Date</u>		Temperatur	e (deg C)	
	Formation temperature imm	nediat	ely post-tre	eatment:							
	Formation temperature pos	t-treat	ment mon	itoring even	t 1:	-			-		
	Duration of post-treatment	monito	oring (days	s):		24 months					
<u>x</u>	Mass of contaminant remov	/ed:									
	Via li	quid p	oumping:					_ lb	kg	Unknown	
	In va	por st	ream:					_ lb	kg	Unknow	
	Tota	l:			4400	<u>00</u>	<u>x</u>	lb	kg	Unknown	
	Comments:										
	Electrodo	enac	ning of 10	ft-	vanort roc	orven, welle	enacina	of 40 ft-	22 vanor	and 18 dural	
	<u>electrode</u> phase ext			11,	vapon 180	corvery wells	<u>spacini</u>	UI 4U II,	∠s vapor	and 18 dural	
	Attachments:										

Cos	st and Performano	e				Facility ID#:	0380
<u>x</u>	Performance						
_	Remediation Go	oal:					
		<u>x</u> In 0	Groundwater:	Cleanup in ug/L - Benezene-	469, Benzo(a)pyrene-2; ben ohthalene-428: Toluene-131	zo(b)fluoranther	ne-2: chrysene-2;
		v In S	Soil:	<u>lla</u>	onthalerie-428: Toluerie-131	<u>3000</u>	
		<u>x</u> In S	Cleanu	p in mg/kg - benzene-0.44; b ethylbenzene-389: indeno(1	enzo(a)pyrene-6.8: benzo(2,3-cd)pyrene-0.66: Toluen	o)fuoranthene-24 e-2050: total xy	4.0: chrysene-10 lenes-700
	Was the Remed	diation Goa	al Achieved:				
		<u>x</u> In 0	Groundwater				
			Comment:				
			<u>ye</u>	s, except for a benzene at 733	ug/L		
		<u>x</u> In S	Soil				
			Comment:				
			ye	<u>s</u>			
	General comme	ents on the	thermal applica	tion:			
	Lessons Learne	nd.					
							
<u>x</u>	Energy						
^	Total Energy Us	sed:	<u>167800</u>	<u>x</u>	kWhr kWhr/m ³	kWł	ar/vd ³
			ergy applied to tr	=	KWIIIKWIII/III	kWhr/m ³	kWhr/yd ³
						kWhr/m³	kWhr/yd ³
		_ Other en				. KVVIII/III	KVVIII/yd
			Please	note other energy:			
<u>x</u>	Cost						
_	Total Project Co	ost:		1301169			
		_ Consulta	int Cost:				
		 '	Vendor Cost:		•		
		Energy C		<u>259000</u>	m³	_yd³	
	<u>X</u>	Other Co				, yu	
	<u>X</u>			<u>1042169</u>			
		Other Co			•		
		_ Other Co					
	x Please no	te other co	ost: <u>x</u>	Other Cost 1:	ERH system operation	and maintenand	<u>ce</u>
				Other Cost 2:			

Other Cost 3:

General Site Information Facility ID#: 0390 File Analyzed By: PD ____ Date: 9/18/2006 ____Other: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _ Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: Dec-95 End of Test: 1-Sep Duration: 5.5 years Type of Site: ____Non-DOD __ DoD Facility Name: AG Communications 400 North Wolfe Rd Address: City, State, Zip Code: North Lake, IL OU# or Site #: Primary point of contact: Organization: Address: City, State, Zip Code: email: ____ Phone #: Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Consultant _____ Vendor, Technical Applications Type: ____Other Organization: ___ Address: _ City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data _ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information Flux assessment

Geologic cross-section

____ Groundwater elevations

Hydraulic Conductivity information

nent zone: Upg Upg ith pre-treatment data: ith post-treatment data:	data: Pre-treatment: gradient: Mumber outsid	zone definition attachment	Post-treatment: Cros Cros	ssgradient:ssgradient:	
nent zone: Upg Upg ith pre-treatment data: ith post-treatment data:	data: Pre-treatment: gradient: Mumber outsid	t: Downgradient: _ Downgradient: _ de treatment zone:	Post-treatment: Cros Cros	Average Post-treatmer	nt Concentration per ical:
nent zone: Upg Upg ith pre-treatment data: ith post-treatment data:	Pre-treatment: gradient: gradient: Number outsid	Downgradient: _ Downgradient: _ de treatment zone: Average Pre-treatment Chemi	Cros Cros tt Concentration per	Average Post-treatmer	nt Concentration per ical:
Upg Upg ith pre-treatment data: ith post-treatment data:	gradient:	Downgradient: de treatment zone: Average Pre-treatmen Chemi	nt Concentration per	Average Post-treatmer	ical:
Upg ith pre-treatment data: ith post-treatment data: in Hydrocarbons	gradient:	Downgradient: de treatment zone: Average Pre-treatmen Chemi	nt Concentration per	Average Post-treatmer	ical:
ith pre-treatment data: ith post-treatment data:	:Number outsid	de treatment zone: Average Pre-treatmen Chemi	nt Concentration per ical:	Average Post-treatmer Chemi	ical:
n Hydrocarbons	Number outsid	Average Pre-treatmer Chemi	ical:	Chemi	ical:
n Hydrocarbons	Number outsid	Average Pre-treatmer Chemi	ical:	Chemi	ical:
n Hydrocarbons	Number outsid	Average Pre-treatmer Chemi	ical:	Chemi	ical:
	Other	Average Pre-treatmer Chemi	ical:	Chemi	ical:
		Chemi	ical:	Chemi	ical:
		Chemi	ical:	Chemi	ical:
	a .				
ne	Creosote	10 mg/L	None	0.1 mg/L	None
el		None	None	None	None
alene		None	None	None	None
ene		None	None	None	None
e		None	None	None	None
benzene		None	None	None	None
ylene		None	None	None	None
ene		None	None	None	None
		None	None	None	None
		None	None	None	None
		None	None	None	None
		None	None	None	None
		None	None	None	None
		None	None	None	None
		None	None	None	None
		None	None	None	None
				None	None
			None None None None None None	None None None None None None None None None None None None	None None None None None None None None None None None None None None None

Impacted 160,000 ft2 total with VOC impacting 11,000 ft2

Attachments:

<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sedir	<u>ments</u>		
		Vadose Zone:	Relatively homo	geneous and permeable	e unconsolidated sedi	ments
			Relatively homo	geneous and impermea	ble unconsolidated se	ediments
			Largely permeal	ole sediments with inter-	-bedded lenses of low	er permeability material
			x Largely imperme	eable sediments with int	er-bedded layers of h	igher permeability material
			Competent, but	fractured bedrock (i.e. c	crystalline rock)	
			Weathered bedr	rock, limestone, sandsto	one	
		Saturated Zone:	Relatively homo	geneous and permeable	e unconsolidated sedi	ments
			Relatively homo	geneous and impermea	ble unconsolidated se	ediments
			Largely permeal	ole sediments with inter-	-bedded lenses of low	er permeability material
			x Largely imperme	eable sediments with int	er-bedded layers of h	igher permeability material
			Competent, but	fractured bedrock (i.e. c	crystalline rock)	
			Weathered bedr	rock, limestone, sandsto	ne	
<u>x</u>	Ground surface eleve	ation based on wells in	or adjacent to treatment	zone: <u>660</u>	ft amsl	Unknown
<u>x</u>	Aquifer Characteristi	cs:				
	Is more than 1 aquife	er present?	No Yes	s (number):	<u>x</u> Unk	nown (assume single aquifer)
			Aquifer 1	Aquifer 2	Aquifer 3	
	Depth to water:	low value (ft bgs):	<u>37</u>			
		high value (ft bgs):	<u>440</u>			
		Unknown:				
<u>x</u>	Flow direction		ESE			
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):				<u>x</u> Unknown
	Vertical hydraulic gra	adient (feet/foot):				<u>x</u> Unknown
<u>x</u>	K range (ft/day)	Measured	d using: Slug	Test Labor	ratory	_ Field data
		low	see comments			Unknown
		high				
	Transmissivity (ft2/da	ay): Measured	d using: Slug	Test Labor	ratory	_ Field data
		low				<u>x</u> Unknown
		high				
	Comments:					
	<u>Se</u>	e attached map (Figu	re 1-4)			

Facility ID#:

0390

Figure 1-4

Attachments:

Hydrogeologic Conceptual Model

The	rmal Treatment -	Design								F	acility ID#:	0390	
<u>x</u>	Thermal treatm	ent:	Co	nductiv	/e								
		_	El	ectrical	Resistance								
		<u>></u>	c Ste	eam	_ 3 phase	_	6 phase		_ AC _I	power	Do	C power	
		<u> </u>		<u>x</u>	Steam	_	Steam + air	_	_ Stea	m + O2			
	T (T t.	-		her (des		1.6.							
X	Type of Test:		Pilot test		_	-scale Syste		aabla uu		lidotod s	adimente		
<u>x</u>	Geology of Tre	alment Zone.				_	eous and perme						
					-	_	eous and imper sediments with i					ability mat	orial
				<u>x</u>			le sediments with				•	-	
						-	tured bedrock (i			-	or migner per	meability ii	natonai
				_	_		, limestone, san	-	iuiii io	roon			
<u>x</u>	Treatment Targ	je Zone:	s Sa	turate			dose only		Both	(Saturate	ed and Vados	e zones)	
<u>x</u>	Start of Therma	_	Dec-95				Duratio			(======================================		,	
<u>x</u>	Hydraulic Cont	rol <u>></u>	Ye	:s	No								
<u>x</u>	Treatment Cell	Design:											
	Size of target z	one (ft2):				30800				_ Unknov	vn (_ x _	ft)
	Thickness of ta	rget zone (ft):						_	<u>x</u>	Unknov	vn		
	Depth to top of	target zone (f	t bgs):			<u>37</u>				_ Unknov	vn		
	Thickness of ta	rget zone beld	ow wate	r table	(ft):			_	<u>x</u>	Unknov	vn		
	Number of ene	rgy delivery po	oints:			<u>57</u>				_ Unknov	vn		
	Number of extr	action points:				<u>282</u>				_ Unknov	vn		
<u>x</u>	Temperature P	rofile:											
^	Initial formation		(dea C)	:						<u>x</u>	Unknow	n	
	Maximum repre	·			ature (dea C	;):				<u>x</u>			
	Time to reach r									x			
	Duration of trea	•								<u>x</u>		n	
							<u>D</u>	ate_			Temperati	ure (deg C)	<u>)</u>
	Formation temp	perature imme	diately	post-tr	eatment:					_			_
	Formation temp	perature post-	treatme	nt mor	itoring even	it 1:	-			_			_
	Duration of pos	t-treatment m	onitorin	g (days	s):					_			
	Mass of souton	-:	.انہ										
<u>x</u>	Mass of contan		u. uid pun	nina:					_ lb		ka	,	Unknowi
		•	or strea						_ lb		kg kg		Unknowi
		Total:	01 01100			40.0	000	<u>x</u>	_ lb		kg		Unknowi
								_			&		
	Comments:	Injection w									Extra	ction Well	s - 205
		vapor only: Hydraulic o				W only							
	Attachments:												

Cost and Performance				Fac	ility ID#:	0390
Performance						
Remediation Goal:						
	In Groundwater: —					
	_				-	
	In Soil:					
Was the Remediati	on Goal Achieved:					
_	In Groundwater					
	Comment: -					
	_					
_	In Soil					
	Comment: -					
	_					
General comments	on the thermal applica	ation:				
-						
Lessons Learned						
-						
_						
Energy				3		3
Total Energy Used:			kWhr	kWhr/m ³		
	otal energy applied to t	reatment zone:			nr/m³	kWhr/yd ³
Ot	ther energy:	_		kWh	ır/m³	kWhr/yd ³
	Please	note other energy:	-		-	
<u>x</u> Cost						
Total Project Cost:	5 600	000 (includes pilot)				
· · · · · · · · · · · · · · · · · · ·	onsultant Cost:	oce (morados pilot)				
	nermal Vendor Cost:					
	nergy Cost:	-	 m	³ yd ³		
			m	ya		
· 	ther Cost 1:	-				
· 	ther Cost 2:					
· 	ther Cost 3:					
Please note of	other cost:	Other Cost 1:				
		Other Cost 2:				

_ Other Cost 3:

File Analyzed By: PD ____ Date: 9/18/2006 ____Other: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test ___ Full Scale System End of Test: <u>1994</u> Start of Test: 1993 Duration: _____ Type of Site: __ DoD ____Non-DOD Facility Name: AG Communications 400 North Wolfe Rd Address: City, State, Zip Code: North Lake, IL OU# or Site #: Primary point of contact: Organization: Address: City, State, Zip Code: email: ____ Phone #: Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Consultant _____ Vendor, Technical Applications Type: ____Other Organization: ___ Address: _ City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data _ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information Flux assessment ____ Groundwater elevations Geologic cross-section

Facility ID#:

0391

General Site Information

Hydraulic Conductivity information

Impacted	Impacted zone a	w direction)(ft.): <u>Below</u> as defined by documentation nod for determining size of im	Width (ft):		ness (ft):	<u> </u>	Unknown
Monitor V	Wells: Number of relevant n	monitoring wells with groundw					None
	Number of wells related	tive to treatment zone:	Pre-treatme	ent:	Post-treatment:		
	Pre-treatment	In:	Upgradient:	_ Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	-	oil borings with pre-treatment oil borings with post-treatmen ent zone:	t data:	side treatment zone:			
Types of C	Contaminants			Average Pre-treatme		Average Post-treatme	
				Chem	ical:	Chen	ncar:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Chlorinated Solvents <u>x</u> Trichloroethene	Petroleum Hydrocarbons Hexane	Other <u>Creosote</u>				
		Ž		Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane		Groundwater (mg/L) 10 mg/L	Soil (mg/kg) None	Groundwater (mg/L) 0.1 mg/L	Soil (mg/kg) None
	<u>x</u> TrichloroetheneTetrachloroethene	Hexane Jet Fuel		Groundwater (mg/L) 10 mg/L None	Soil (mg/kg) None None	Groundwater (mg/L) 0.1 mg/L None	Soil (mg/kg) None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene	Hexane Jet Fuel Napthalene		Groundwater (mg/L) 10 mg/L None None	Soil (mg/kg) None None None	Groundwater (mg/L) 0.1 mg/L None None	Soil (mg/kg) None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene	Hexane Jet Fuel Napthalene Benzene		Groundwater (mg/L) 10 mg/L None None None	Soil (mg/kg) None None None None	Groundwater (mg/L) 0.1 mg/L None None None	Soil (mg/kg) None None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene	Hexane Jet Fuel Napthalene Benzene Tolune		Groundwater (mg/L) 10 mg/L None None None None	Soil (mg/kg) None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None	Soil (mg/kg) None None None None None
homicals of	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane	Hexane Jet Fuel Napthalene Benzene Tolune Ethylbenzene		Groundwater (mg/L) 10 mg/L None None None None None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None	Soil (mg/kg) None None None None None None
hemicals of Concern	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None None None None None None None	Soil (mg/kg) None None None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None None	Soil (mg/kg) None None None None None None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None None None None None None None None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L)	Soil (mg/kg) None None None None None None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2-trichloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None None None None None None None None None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None None None None None	Soil (mg/kg) None None None None None None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-tetrachloroethane 1,1,2-tetrachloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None None None	Soil (mg/kg) None None None None None None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-tetrachloroethane 1,1,2-tetrachloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None None None	Soil (mg/kg) None None None None None None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-tetrachloroethane 1,1,2-tetrachloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None None None	Soil (mg/kg) None None None None None None None None
	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-tetrachloroethane 1,1,2-tetrachloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None None None	Soil (mg/kg) None None None None None None None None
Chemicals of Concern	X Trichloroethene Tetrachloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-tetrachloroethane 1,1,2-tetrachloroethane	HexaneJet FuelNapthaleneBenzeneToluneEthylbenzenem/p-xylene		Groundwater (mg/L) 10 mg/L None None	Soil (mg/kg) None None None None None None None None	Groundwater (mg/L) 0.1 mg/L None None None None None None None None	Soil (mg/kg) None None None None None None None None

Impacted 160,000 ft2 total with VOC impacting 11,000 ft2

<u>x</u>	Geology:	Zone	Unconsolidated Sediments
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			Largely permeable sediments with inter-bedded lenses of lower permeability material
			x Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			Largely permeable sediments with inter-bedded lenses of lower permeability material
			x Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
			Weathered bedrook, inflestone, sandstone
<u>x</u>	Ground surface eleva	ation based on wells in o	r adjacent to treatment zone: 660 ft amsl Unknown
<u>x</u>	Aquifer Characteristic	cs:	
	Is more than 1 aquife	r present?	No Yes (number): <u>x</u> Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3
	Depth to water:	low value (ft bgs):	<u></u>
		high value (ft bgs):	440
		Unknown:	
<u>x</u>	Flow direction		<u>ESE</u>
<u>x</u>	Horizontal hydraulic g	gradient (feet/foot):	<u> </u>
	Vertical hydraulic gra	dient (feet/foot):	<u>X</u> Unknown
<u>x</u>	K range (ft/day)	Measured	using: Slug Test Laboratory Field data
		low	see comments Unknown
		high	
	Transmissivity (ft2/da	y): Measured	using: Slug Test Laboratory Field data
	, ,	low	<u>x</u> Unknown
		high	
		9	
	Comments:		
	Attachments:		

Facility ID#:

0391

See attached x-section

Hydrogeologic Conceptual Model

Ther	rmal Treatment - Design							F	acility ID#:	<u>0391</u>
<u>x</u>	Thermal treatment:	Cor	nductive							
		Ele	ctrical Re	esistance						
				3 phase		_ 6 phase	A	.C power	DO	C power
		X Stea		Steam		_ Steam + air	S	team + O2		
		Oth	er (descr	ribe)						
<u>x</u>	Type of Test:	Pilot test		x Full-	scale System	n				<u> </u>
x	Geology of Treatment Zone	_'		_	•	ous and permea	able uncor	nsolidated s	sediments	
	U			-	_	ous and imperm				
				•	•	ediments with in				ability material
			_						•	meability material
						ured bedrock (i.e				·
						limestone, sand				
<u>x</u>	Treatment Targe Zone:	<u>x</u> Sat				ose only		oth (Saturat	ed and Vadose	e zones)
<u>x</u>	Start of Thermal Test:	1993								
	Hydraulic Control	Yes		No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):						_ <u>x</u>	Unknov	wn (_ x ft)
	Thickness of target zone (ft	:):					_ <u>x</u>	Unknov	wn	
	Depth to top of target zone	(ft bgs):					_ <u>x</u>	Unknov	wn	
	Thickness of target zone be	elow water	table (f	t):			<u>x</u>	Unknov	wn	
	Number of energy delivery	points:					_ <u>x</u>	Unknov	vn	
	Number of extraction points	s:					_ <u>X</u>	Unknov	wn	
v	Tomporatura Profile:									
<u>x</u>	Temperature Profile: Initial formation temperature	o (dog C):						v	Unknow	
	Maximum representative fo			ire (dea C	١٠			<u>x</u>		
	Time to reach maximum re		-						•	
	Duration of treatment at rep		-		-			<u>x</u>	•	
	Duration of troutment at rep	roooman	o tompo	orataro (aa	.yo).			^	Clikilow	
						<u>Da</u>	<u>ite</u>		Temperatu	ure (deg C)
	Formation temperature imn	nediately p	ost-trea	ıtment:						
	Formation temperature pos	t-treatmer	nt monito	oring event	t 1:					
	Duration of post-treatment	monitoring	(days):							
<u>x</u>	Mass of contaminant remov	ved:								
_		iquid pum	oing:				lb)	kg	Unknown
		por strear	•				11:		kg	Unknown
	Tota	•			500)	<u>x</u> ll		kg	Unknown
						•	_	_		
	Comments:	-			-					
								_		
	Attachments:									

Cos	st and Performance				Facility ID#:	<u>0391</u>
	_ Performance					
	Remediation Goal:					
		In Groundwater: —				
		In Soil:				
	Was the Remediation					
	_	In Groundwater				
		Comment: —				
		_				
	_	In Soil				
		Comment: —				
		_				
	General comments	on the thermal applica	ation:			
			.			
	Lessons Learned					
	-					
	_					
	_ Energy				 	3
	Total Energy Used:	· · · · · · · · · · · · · · · · · · ·		kWhr		
		tal energy applied to to	reatment zone:		_ kWhr/m ³	kWhr/yd ³
	Oth	ner energy:	_		 _ kWhr/m ³	kWhr/yd ³
		Please	note other energy:			
<u>x</u>	Cost					
_	Total Project Cost:					
	•	nsultant Cost:				
		ermal Vendor Cost:				
		ergy Cost:			 _ yd³	
		ner Cost 1:			 _ ,~	
		ner Cost 1:				
		ner Cost 3:	Othor Ct 4:			
	Please note of	iner cost:	Other Cost 1:			
		_	Other Cost 2:			

____ Other Cost 3:

File Analyzed By: JT <u>x</u> PD ____ Date: 10/18/2006 ____Steam ____Other: Type of treatment: ____ Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ____ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: ____ Pilot Test ___ Full Scale System Start of Test: Jul-04 End of Test: Nov-04 Duration: _____ ____Non-DOD Type of Site: __ DoD Facility Name: <u>Iowa Department of Transportation</u> Address: City, State, Zip Code: Sioux City, IA OU# or Site #: _ Primary point of contact: Bill Heath Organization: **CES** Address: 419 Entiat St., Suite A City, State, Zip Code: Kennewick, WA 99336 Phone #: <u>509-727-4276</u> email: bill@cesiweb.com Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0395

General Site Information

____ Hydraulic Conductivity information

General Site As	sessment Data					Facility II	D#: <u>0395</u>
Impacted	Impacted zone a				ness (ft):		Unknown
Monitor V		nonitoring wells with ground	water data:				None
	Number of wells relat Pre-treatment Post-treatment	ln:	Pre-treatment: Upgradient: Upgradient:	Downgradient:		ssgradient:ssgradient:	
Soil Boring		oil borings with pre-treatment oil borings with post-treatmen ent zone:	nt data:	treatment zone:			
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	x Benzene		None	None	None	None
	trans-1,2-dichloroethene	x Tolune		None	None	None	None
	1,1-dichloroethane	<u>x</u> Ethylbenzene		None	None	None	None
	1,2-dichloroethane	x m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	x o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
Concom	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	Hone	None	rvone
Comme	nts:						
Attachmer	nts:						
	-						_

Hydrogeologic Conceptual Model Facility ID#: 0395 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone _ Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): 9 high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: __ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory _ Field data low ____ Unknown high Comments:

The	ermal Treatment - Design								Facility ID#:	<u>0395</u>
<u>x</u>	Thermal treatment:		_ Conductive							
		<u>x</u>	Electrical R	tesistance						
				3 phase	6	phase		AC power	DO	power
			_ Steam							
				Steam	S	team + air		Steam + O2	!	
			Other (desc							
	_ Type of Test:	Pilot		·	cale System					
<u>x</u>	Geology of Treatment Zo	one:			homogeneou					
				-	-	•			ted sediments	ability material
									•	ability material meability material
			<u>x</u>		t, but fracture			-	3 of flighter per	meability material
				-	l bedrock, lim		-			
	_ Treatment Targe Zone:		Saturated	-	Vadose			Both (Satur	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	Jul-0	=	•		•				,
	_ Hydraulic Control		Yes	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				3800			Unkn	own (_ x ft)
	Thickness of target zone	(ft):			<u>10</u>			Unkn	own	
	Depth to top of target zo	ne (ft bg	s):		<u>4</u>			Unkn	own	
	Thickness of target zone	below v	vater table (ft):	<u>5</u>			Unkn		
	Number of energy delive		5 :		<u>19</u>			Unkn		
	Number of extraction poi	nts:			<u>12</u>			Unkn	own	
	_ Temperature Profile:									
	Initial formation tempera	ture (dec	a C):						Unknow	1
	Maximum representative		-	ure (deg C)	-				Unknow	
	Time to reach maximum		•						Unknow	n
	Duration of treatment at	represer	ntative temp	erature (day	/s):				Unknow	n
						<u>Dat</u>	<u>te</u>		Temperatu	ire (deg C)
	Formation temperature in	mmediat	ely post-tre	atment:	_					
	Formation temperature p	ost-trea	tment monit	oring event	1: _					
	Duration of post-treatme	nt monite	oring (days)	:	_					
<u>x</u>	Mass of contaminant ren	noved:								
~			pumping:					lb	kg	Unknown
		vapor s					-	lb	kg	Unknown
	To	otal:			<u>3700</u>		<u>x</u>	lb	kg	Unknown
	Comments:									
	<u>19 ft sp</u>	acina								
	Attachments:									

Cost and Performance Facility ID#: 0395

<u>x</u>	Performance		
	Remediation Goal:		
	In Groundy	vater:	
	<u>x</u> In Soil:		
			Benzene = 4.38 mg/kg
	Was the Remediation Goal Achiev	ved:	
	In Groundy	water	
	Comr	ment:	
	In Soil		
	Comr	ment:	
	General comments on the therma	al application:	
	Lessons Learned		
<u>x</u>	Energy		
		<u>588812</u>	\underline{x} kWhr kWhr/m ³ kWhr/yd ³
	<u>x</u> Total energy app	olied to treatment zone:	515312 kWhr kWhr/m ³ kWhr/yd ³
	<u>x</u> Other energy:		73500 kWhr kWhr/m ³ kWhr/yd ³
	<u>X</u>	Please note other energy:	process equipment
	_ Cost		
	Total Project Cost:		
	Consultant Cost:	· ·	
	Thermal Vendor	Cost:	
	Energy Cost:	-	m³ yd³
	Other Cost 1:	-	
	Other Cost 2:		
	Other Cost 3:		
	Please note other cost:	Other Cost 1:	
		Other Cost 2:	
		Other Cost 3:	

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	10/30/2006
	Type of treatment:	Conductive	Steam	<u>x</u> ERH	Other:		
	Type of Contaminant:	Chlorinated Solv	ents _	Petroleum Hydro	ocarbons	Pesticides	
		Wood Treating		Other:			
	Treatment Status:	Active	<u>x</u> Post				
	Type of Test:	Pilot Test	Full Sca	le System			
	Start of Test:		En	d of Test:		_ Duration:	
	Type of Site:	<u>x</u> Non-DOD	DoD				
x	Facility Name: <u>Circuit As</u> Address:	sembling Facility					
	City, State, Zip Code:	Harwood Heights, IL					
	OU# or Site #:						
<u>x</u>	Primary point of contact:	Jeff Pope					
	Organization: <u>Clayton G</u>	oup					
	Address: 3140 Finley Rd						
	City, State, Zip Code:	Downers Grove, IL					
	Phone #: 630-795-3211		email: <u>ip</u>	ope@claytongrp.com			
<u>x</u>	Other contacts or vendors wh	no worked on site		None			
	Point of contact: <u>Bill</u>	<u>Heath</u>					
	Type: Vendor, C	onsultant	_ Vendor, Tech	nical Applications	Oth	ier	
	Organization: <u>CES</u>						
	Address: 419 W. Entiat St						
	City, State, Zip Code:	Kennewick, WA 99336	<u>5</u>				
	Phone #: <u>509-727-4276</u>		email: bi	I@cesiweb.com			
Q	A/QC						
	_Characteristics of Interest						
	Good pre- and post-tre	atment groundwater data	ı	Good pre-	and post-treatment	nt soil data	
	Good temperature prof	file vs. time information		Flux asses	sment		
	Groundwater elevation	as		Geologic o	eross-section		
	Hydraulic Conductivit	y information					

Facility ID#:

0400

General Site Information

General Site As	ssessment Data					Facility II	D#: <u>0400</u>
Impacted	5 "		Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
		=	npacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor	Wells: Number of relevant m	nonitoring wells with ground	water data:				None
			Pre-treatment:		Post-treatment:		
	Number of wells relat	tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin	gs: Number of relevant so	oil borings with pre-treatment	data:				
	Number of relevant so	oil borings with post-treatmer	nt data:				
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Types of	Contaminants	T	T	T		T	
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Cher	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
0	onto:						
Comme	±1115.						
Attachme	nts:						

Hydrogeologic Conceptua	Il Model		Facility ID#: 0400
Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated see Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated see Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	diments sediments over permeability material higher permeability material diments sediments over permeability material
Ground surface elev		adjacent to treatment zone: ft amsl	Unknown
Is more than 1 aquif		No Yes (number): U	nknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3	-
Flow direction			-
Horizontal hydraulic gra			Unknown
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
Transmissivity (ft2/d	low high ay): Measured low high	using:Slug TestLaboratory	Unknown Field data Unknown
Comments:			
Attachments:			

The	ermal Treatment - Design							Facility ID#:	0400
<u>x</u>	Thermal treatment:		_ Conductive	e					
		<u>x</u>	Electrical l	Resistance					
				_ 3 phase		6 phase	AC po	wer D	C power
			_ Steam						
				Steam	_	Steam + air	Steam	+ O2	
			Other (des	cribe)					
_	Type of Test:	Pilo	test	Full-	-scale Syst	em			
	_ Geology of Treatment Zor	ne:	_	_ Relatively	homoger	neous and perme	able unconsolic	lated sediments	
				_ Relatively	homoger	neous and imperr	neable unconso	lidated sediments	
								ses of lower perme	-
				_ Largely in	npermeab	le sediments with	n inter-bedded la	ayers of higher per	meability material
				_ Competer	nt, but frac	ctured bedrock (i.	e. crystalline ro	ck)	
				_ Weathere	ed bedrock	k, limestone, sand	dstone		
_	Treatment Targe Zone:		_ Saturated	only	Va	dose only	Both (S	Saturated and Vados	e zones)
_	_ Start of Thermal Test:					Duration	n:		
	Hydraulic Control		_Yes	No					
	Treatment Cell Design:								
	Size of target zone (ft2):						Ţ	Jnknown (_ x ft)
	Thickness of target zone (ft):						Jnknown	
	Depth to top of target zon		ıs):					Jnknown	
	Thickness of target zone I			(ft):				Jnknown	
	Number of energy delivery			. ,				Jnknown	
	Number of extraction poin							Jnknown	
	,								
	Temperature Profile:								
	Initial formation temperatu	ıre (de	g C):					Unknow	n
	Maximum representative to			ture (deg C	;):			Unknow	n
	Time to reach maximum r		•					Unknow	n
	Duration of treatment at re				-			Unknow	n
					• /				
						Da	ate_	Temperat	ure (deg C)
	Formation temperature im	media	tely post-tre	eatment:					
	Formation temperature po	st-trea	tment moni	itoring even	it 1:				
	Duration of post-treatmen	t monit	toring (days):					
_	Mass of contaminant remo	oved:							
	Via	liquid	pumping:				lb	kg	Unknow
	In v	apor s	stream:				lb	kg	Unknow
	Tot	al:					lb	kg	Unknow
	Commonto								
	Comments:								
	Attachments:								
			_						

and Performance					Facility ID#:	<u>0400</u>
_ Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_	·					
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k!	Whr/vd ³
	tal energy applied to t	reatment zone:	ĸ ‹‹ iii		 _ kWhr/m³	kWhr/yc
	ner energy:				_ kWhr/m ³	kWhr/yc
Ou					_ KVVIII/III	KVVIII/yC
	Please	note other energy:				
Cost						
Total Project Cost:						
-	nsultant Cost:					
	ermal Vendor Cost:					
					 3	
	ergy Cost:			.m	_ yd³	
	ner Cost 1:					
	her Cost 2:					
	ner Cost 3:	-				
Please note of	ther cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

PD ____ File Analyzed By: Date: 11/1/2006 ____Steam ____Other: Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating _Other: Treatment Status: ___ Active Post X Type of Test: ___ Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: _____ Type of Site: ___DoD Non-DOD Facility Name: <u>Electronics Manufacturing Facility</u> Address: City, State, Zip Code: Chicago, IL OU# or Site #: Primary point of contact: Bill Heath Organization: Address: 419 W Entiat St City, State, Zip Code: Kennewick, WA 99336 Phone #: <u>509-727-4276</u> email: bill@cesiweb.com Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0410

General Site Information

____ Hydraulic Conductivity information

Impacted Zone	. Longth (norolle) to fle	w direction)(ft.):	Width (ft):	Thiale	ness (ft):		U
impacted Zone	- "	as defined by documentation		Thick	ness (it).		
	· · · · · · · · · · · · · · · · · · ·	hod for determining size of im		e zone definition attachmen	ts)		
	Map attachmen		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		,		
Monitor Wells	: Number of relevant	monitoring wells with groundy	vater data:				No
			Pre-treatme	ent:	Post-treatment:		
	Number of wells rela	ative to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	t In:	Upgradient:	Downgradient:	Cro	ssgradient:	
Soil Borings:		oil borings with pre-treatment					
		oil borings with post-treatmen					
	Number inside treatn	nent zone:	_ Number ou	tside treatment zone:			
-							
x Types of Conta	aminants						
				Average Pre-treatme Chem	nt Concentration per	Average Post-treatm	ent Conce nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soi
	_ Trichloroethene	Hexane	Creosote	None	None	None	No
×	Tetrachloroethene	Jet Fuel		None	None	None	No
	1,1-dichloroethene	Napthalene		None	None	None	No
	_ cis-1,2-dichloroethene	Benzene		None	None	None	No
	trans-1,2-dichloroethene	Tolune		None	None	None	No
	1,1-dichloroethane	Ethylbenzene		None	None	None	No
	1,2-dichloroethane	m/p-xylene		None	None	None	No
	1,1,1-trichloroethane	o-xylene		None	None	None	No
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	No
	1,1,2,2-tetrachloroethane			None	None	None	No
	_ Vinyl Chloride			None	None	None	No
				None	None	None	No
				None	None	None	No
				None	None	None	No
				None	None	None	No
				None	None	None	No
				None	None	None	No
Comments:							
			Impacted zone	of 13000 yd3 (up to 38 ft l	ogs)		
Attachments:							

Hydro	ogeologic Conceptual	Model		Facility ID#:	<u>0410</u>
x	Geology:	Zone Vadose Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material	ial
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sec Relatively homogeneous and impermeable unconsolidated sec Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of I Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material	ial
	Ground surface elev-	ation based on wells in or	adjacent to treatment zone: ft amsl	Unknown	
X	Aquifer Characteristi Is more than 1 aquife Depth to water:		No Yes (number): Un	known (assume single aquife	er)
	Flow direction				
	Horizontal hydraulic yertical hydraulic gra	. ,		Unknown	
	K range (ft/day)	Measured of low high	using: Slug Test Laboratory	Field data Unknown	
	Transmissivity (ft2/da	· ·	Ising: Slug Test Laboratory	Field data Unknown	
	Comments:				

The	rmal Treatment - Desig	n				Facility ID#: 0410
<u>x</u>	Thermal treatment:	Condu	ctive			
		<u>x</u> Electri	cal Resistance			
			3 phase	6 phase	AC power	DC power
		Steam				
		-	Steam	Steam + air	Steam + O	2
			(describe)			
<u>x</u>	Type of Test:	Pilot test	_	lle System		
<u>x</u>	Geology of Treatment	·-		mogeneous and perme		
		2	-	mogeneous and imperr		
		-				of lower permeability material rs of higher permeability material
		•		but fractured bedrock (i.		
		•		edrock, limestone, sand		
<u>x</u>	Treatment Targe Zon	e: Satura		Vadose only		rated and Vadose zones)
	_ Start of Thermal Test:					
	_ Hydraulic Control	Yes	No			
	_Treatment Cell Design	n:				
	Size of target zone (ft	2):	_		Unk	nown (x ft)
	Thickness of target zo	one (ft):	_		Unk	nown
	Depth to top of target	zone (ft bgs):	_		Unk	nown
	Thickness of target zo	one below water ta	ole (ft):		Unk	nown
	Number of energy del	livery points:	_		Unk	nown
	Number of extraction	points:	_		Unk	nown
	Tarana Darilla					
	_ Temperature Profile:	proture (dea C):				I Indianana
	Initial formation temperature Maximum representation		perature (dea C):			Unknown Unknown
	Time to reach maximi	•		·)·		Unknown
	Duration of treatment	•				Unknown
	Duration of treatment	at representative t	simperature (days)). 		Clikilowii
				Da	ate	Temperature (deg C)
	Formation temperatur	e immediately pos	t-treatment:			
	Formation temperatur			<u> </u>		
	Duration of post-treat	ment monitoring (d	ays):			
	_ Mass of contaminant	removed:				
		Via liquid pumpin	g:		lb	kgUnknown
		In vapor stream:			lb	kgUnknown
		Total:			lb	kg Unknown
	Comments:					
		ated - 12,500 yd3				
	Attachments:					

Cost and Performand	ce				Facility ID#:	0410
Performance						
Remediation G	oal:					
	In Groundwater:					
						
	In Soil:					
						
Was the Remed	diation Goal Achieved:					
	In Groundwater					
	Comment:					
	In Soil					
	Comment:					
General comme	ents on the thermal appl	ication:				
Conordi commi	one on the thomas appr	iodion.				
75% PCE	Reduction					
Lessons Learne	ed.					
Energy						
Total Energy U	sed:		kWhr	kWhr/m ³	kW	hr/yd ³
	Total energy applied to	o treatment zone:		· · · · · · · · · · · · · · · · · · ·	kWhr/m ³	kWhr/yd ³
	Other energy:	o			kWhr/m³	kWhr/yd ³
		se note other energy:				kvviii/yu
	Fleas	se note other energy.	-			
x Cost						
Total Project Co	ost:	120/yd3				
	_ Consultant Cost:					
	Thermal Vendor Cost:					
	_ Energy Cost:			m ³	yd ³	
<u></u> <u>x</u>	Other Cost 1:	30000	00		, -	
Δ		30000	<u></u>			
	Other Cost 2:					
	Other Cost 3:					
<u>x</u> Please no	ote other cost:	x Other Cost 1:		capital co	<u>ost</u>	
		Other Cost 2:				
		Other Cost 3:				

General Site Information Facility ID#: 0412 PD ____ File Analyzed By: Date: 10/16/2006 Type of treatment: Conductive ____ Steam ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: _ Pilot Test Full Scale System Start of Test: End of Test: 3/28/2003 11/18/2002 Duration: 120 d Type of Site: Non-DOD __ DoD Facility Name: Operating Dry cleaner Address: City, State, Zip Code: Chicago, IL suburb OU# or Site #: Primary point of contact: TRS website Organization: Address: City, State, Zip Code: Phone #: email: ____ Other contacts or vendors who worked on site _ None Point of contact: Jeff Pope Type: Vendor, Consultant ____ Vendor, Technical Applications ____ Other Organization: Clayton Group Address: City, State, Zip Code: Chicago, IL Phone #: <u>630-795-3211</u> email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

	General Site Ass	sessment Data					Facility II	D#:	0412
	Impacted 2	5 "		Width (ft):	Thick	xness (ft):	_	U	nknown
			as defined by documentation			-4->			
			=	npacted zone (See source zo	ne definition attachmer	nts)			
		Map attachment							
	Monitor W	/ells: Number of relevant m	nonitoring wells with grounds	water data:				No	ne
				Pre-treatment:		Post-treatment:			
		Number of wells relat	ive to treatment zone:						
		Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
		Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
	Soil Boring		il borings with pre-treatment						
		Number of relevant so	il borings with post-treatmer	nt data:					
		Number inside treatme	ent zone:	_ Number outside	treatment zone:				
	x Types of C	ontaminants	T	1	T		T		
						ent Concentration per nical:	Average Post-treatm Cher	ent Conce	ntration per
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		il (mg/kg)
ľ		Trichloroethene	Hexane	Creosote	None	None	None	No	
I		x Tetrachloroethene	Jet Fuel		None	5,000 mg/kg	None	50 m	
I		1,1-dichloroethene	Napthalene		None	None	None	No	
l		cis-1,2-dichloroethene	Benzene		None	None	None	No	
I		trans-1,2-dichloroethene	Tolune		None	None	None	No	
l		1,1-dichloroethane	Ethylbenzene		None	None	None	No	
l		1,2-dichloroethane	m/p-xylene		None	None	None	No	
I		1,1,1-trichloroethane	o-xylene		None	None	None	No	
l	Chemicals of	1,1,2-trichloroethane	o-xylene		None	None	None	No	
l	Concern	1,1,2-tricinoroethane							
I					None	None	None	No	
l		Vinyl Chloride			None	None	None	No	
l					None	None	None	No	
l					None	None	None	No	
l					None	None	None	No	
l					None	None	None	No	
I					None	None	None	No	
L					None	None	None	No	ne
	Comme	nts:							
	001111101								
		•							
	Attachmen	te:							
	, macinilen								

Hyc	frogeologic Concept	rual Model	Facility ID#:	0412
<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>	
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments	

	Vadose Z	one:	Relativel	y homo	geneous ai	nd permeabl	e unconsolidated	sediments		
			x Relativel	y homo	geneous ai	nd impermea	able unconsolidate	ed sedimen	ts	
			Largely p	ermeat	ole sedime	nts with inter	r-bedded lenses o	f lower perr	neab	ility material
			Largely i	mperme	eable sedin	nents with in	ter-bedded layers	of higher p	erme	ability material
			Compete	ent, but t	fractured b	edrock (i.e.	crystalline rock)			
			Weather	ed bedr	ock, limest	one, sandsto	one			
	Saturated	Zone:	Relativel	y homo	geneous ai	nd permeabl	le unconsolidated	sediments		
			Relativel	y homo	geneous ai	nd impermea	able unconsolidate	ed sedimen	ts	
			Largely p	ermeat	ole sedime	nts with inter	r-bedded lenses o	f lower perr	neab	ility material
			Largely in	mperme	eable sedin	nents with in	ter-bedded layers	of higher p	erme	ability material
			Compete	ent, but f	fractured b	edrock (i.e.	crystalline rock)			
			Weather	ed bedr	ock, limest	one, sandsto	one			
<u>x</u>	Ground surface elevation based	on wells in o	r adiacent to tre	atment	zone:		ft amsl		x	Unknown
-									_	
<u>x</u>	Aquifer Characteristics:									
	Is more than 1 aquifer present?		No	Yes	s (number):		<u>x</u>	Unknown (assum	ne single aquifer)
			Aquifer 1		Aqı	uifer 2	Aquifer 3			
	Depth to water: low value	(ft bgs):	<u>70</u>							
	high value	e (ft bgs):								
	Unknown							_		
	Flow direction									
_	_ Flow direction									
<u>x</u>	Horizontal hydraulic gradient (fee	et/foot):						_	<u>x</u>	Unknown
	Vertical hydraulic gradient (feet/fo	oot):						_	<u>x</u>	Unknown
	W (W)			01	- .					
<u>X</u>	K range (ft/day)	Measured		Siug	Test	Labo	ratory	Field	data	TT-1
		low	2.83E-05							_ Unknown
	Transmississis (#2/de.)	high							1	
	Transmissivity (ft2/day):	Measured	using.	_ Siug	Test	Labo	ratory	Field		TT-1
		low							<u>X</u>	Unknown
		high						_		
	Comments:									
	Attachments:									

The	rmal Treatment - Design									Facil	ity ID#:	041	2
<u>x</u>	Thermal treatment:		_ Conduc	tive									
		<u>x</u>	Electric	al Resistance									
			_	3 phase			6 phase	_	AC power	er	DO	power	:
		_	_ Steam	-									
			_	Steam			Steam + air	_	Steam +	O2			
				describe)	_								
<u>X</u>	Type of Test:	_ Pilot	test	_		System							
<u>X</u>	Geology of Treatment Zon	e:	_		-	_	us and pern						
			<u>x</u>		•	•	us and impe						
			_				diments with				-	-	
			-				sediments w				igher per	meabili	ity material
			-				red bedrock			()			
			_				mestone, sa						
<u>X</u>	Treatment Targe Zone:		_	ted only	<u>X</u>	Vados	se only		Both (Sa	turated ai	nd Vadose	zones)	
<u>X</u>	Start of Thermal Test:		8/2002				Durati	ion: <u>12</u>	<u>20 d</u>				
_	_ Hydraulic Control		_ Yes	No									
<u>x</u>	Treatment Cell Design:												
^	Size of target zone (ft2):				120	0			He	ıknown	(_ x	ft)
	Thickness of target zone (f	+).			19	<u>o</u>			Ur		(_ ^	11)
	Depth to top of target zone		ıc).		4				Ur				
	Thickness of target zone b			ole (ft):	0				Ur				
	Number of energy delivery			().	<u>17</u>				Ur				
	Number of extraction point		·		13				Ur				
	,												
<u>x</u>	Temperature Profile:												
	Initial formation temperatur	e (de	g C):				<u>10</u>				Unknow	n	
	Maximum representative for	ormati	on temp	erature (deg (C):		<u>80</u>				Unknow	n	
	Time to reach maximum re	prese	ntative to	emperature (d	days):		<u>42</u>				Unknow	n	
	Duration of treatment at re	prese	ntative te	emperature (d	lays):		<u>60</u>				Unknow	n	
								<u>Date</u>		<u>Te</u>	emperatu	ıre (de	g C)
	Formation temperature imr	nedia	tely post	-treatment:									
	Formation temperature pos	st-trea	tment m	onitoring eve	nt 1:		-						
	Duration of post-treatment	monit	oring (da	ays):									
<u>x</u>	Mass of contaminant remo												
	Via	liquid	pumping	ı: <u> </u>				_	lb		kg	<u>x</u>	Unknown
			tream:	_				_	lb	-	kg	<u>X</u>	Unknown
	Tota	al:		_				_	lb	-	kg	<u>X</u>	Unknown
	Comments:												
	Augusta												
	Attachments:												
			_		_	_	_	_			_		

Cost and Performance Facility ID#: 0412

<u>X</u>	Performance		
	Remediation Goal:		
		_ In Groundwater:	
	<u>x</u>	In Soil:	
			All PCE samples to less than 529 mg/kg
	Was the Remediatio		
		Comment:	
	<u>x</u>	In Soil	
		Comment:	
			Yes, average PCE concentration = 62 mg/kg
	General comments of	on the thermal appl	cation:
	-		
	Lessons Learned		
	_ Energy		
	Total Energy Used:		kWhrkWhr/m³kWhr/yd³
	Tota	al energy applied to	
	Oth	er energy:	kWhr/m³ kWhr/yd³
		Pleas	e note other energy:
	_ Cost		
			
	Total Project Cost:		
		nsultant Cost:	
		ermal Vendor Cost:	
		ergy Cost:	m³ yd³
		er Cost 1:	
	Oth	er Cost 2:	
	Oth	er Cost 3:	
	Please note otl	her cost:	Other Cost 1:
			Other Cost 2:
			Other Cost 3:

File Analyzed By: PD ____ Date: 10/16/2006 Type of treatment: Conductive ____ Steam <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: 6/25/2003 End of Test: 7/15/2005 Duration: 751 Type of Site: ___Non-DOD __ DoD Facility Name: Lockformer Site Address: City, State, Zip Code: Lisle, IL 60532 OU# or Site #: Primary point of contact: Steve Faryan Organization: EPA Region 5 Address: City, State, Zip Code: Phone #: 312-353-9351 email: faryan.steve@epa.gov Other contacts or vendors who worked on site _ None Point of contact: Stan Komperda Type: ___ Vendor, Consultant ___ Vendor, Technical Applications Other Organization: <u>IL EPA</u> Address: _ City, State, Zip Code: Springfield, IL Phone #: <u>217-782-5504</u> email: stan.komperda@epa.state.il.us QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0415

General Site Information

___ Hydraulic Conductivity information

Ge	eneral Site As	sessment Data					Facility II	D#: <u>0415</u>	
Impacted Zone:		5 "	Length (parallel to flow direction)(ft.): Width (ft): Thickness (ft): Impacted zone as defined by documentation						
		Alternative metho	od for determining size of im	npacted zone (See source zo	ne definition attachmer	ts)			
_		None							
			Pre-treatment: Post-treatment: Number of wells relative to treatment zone:						
		Pre-treatment Post-treatment	In:	Upgradient:	Downgradient: Downgradient:		ssgradient:		
_	Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:					
			il borings with post-treatmer						
		Number inside treatme	ent zone:	_ Number outside	treatment zone:				
<u>x</u>	Types of C	Contaminants							
					Average Pre-treatme	nt Concentration per nical:		ent Concentration per nical:	
_		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Chemicals of Concern	x Trichloroethene	Hexane	Creosote	None	None	None	None	
		x Tetrachloroethene	Jet Fuel		None	None	None	None	
		1,1-dichloroethene	Napthalene		None	None	None	None	
		cis-1,2-dichloroethene	Benzene		None	None	None	None	
		trans-1,2-dichloroethene	Tolune		None	None	None	None	
		1,1-dichloroethane	Ethylbenzene		None	None	None	None	
		1,2-dichloroethane	m/p-xylene		None	None	None	None	
		1,1,1-trichloroethane	o-xylene		None	None	None	None	
		1,1,2-trichloroethane			None	None	None	None	
		1,1,2,2-tetrachloroethane			None	None	None	None	
		Vinyl Chloride			None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
Comments:									
	Comme	nis.							
									
	Attachmen	nts:							

Hyd	rogeologic Conceptua	al Model				Facility ID#:	0415		
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sedi	ments_					
		Vadose Zone:	Relatively homo	geneous and permeable	unconsolidated sedir	ments			
			x Relatively homo	geneous and impermeat	ole unconsolidated se	diments			
			Largely permea	ble sediments with inter-b	pedded lenses of low	er permeability mate	erial		
			Largely imperme	eable sediments with inte	er-bedded layers of hi	gher permeability m	aterial		
			fractured bedrock (i.e. cr	i.e. crystalline rock)					
			Weathered bedi	ock, limestone, sandstor	ne				
		Saturated Zone:	Relatively homo	geneous and permeable	unconsolidated sedir	diments			
			Relatively homo	geneous and impermeat	ole unconsolidated se	diments			
			Largely permea	ble sediments with inter-b	pedded lenses of low	er permeability mate	erial		
			Largely imperme	eable sediments with inte	er-bedded layers of hi	gher permeability m	aterial		
			Competent, but	fractured bedrock (i.e. cr	ystalline rock)				
			Weathered bedi	ock, limestone, sandstor	ne				
	_ Ground surface ele	vation based on wells in	or adjacent to treatment	zone:	ft amsl	Unknow	wn		
<u>x</u>	Aquifer Characteris	itics:							
	Is more than 1 aqui	ifer present?	No Ye	s (number):	Unk	nown (assume single a	aquifer)		
			Aquifer 1	Aquifer 2	Aquifer 3				
	Depth to water:	low value (ft bgs):	<u>55</u>						
		high value (ft bgs):		·					
		Unknown:							
_	_ Flow direction								
	Hadaaatal baabaadh					** 1			
Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot):						Unknow			
	vertical hydraulic gi	radient (feet/foot):				Unknow	vn		
	_ K range (ft/day)	Measure	d using: Slua	Test Labora	itory	Field data			
	_	low			·	Unknow	wn		

____ Slug Test

____ Laboratory

____ Field data

____ Unknown

high

low high

Measured using:

Transmissivity (ft2/day):

Comments:

Ther	rmal Treatment - Design												Facili	ty ID#:	<u>0415</u>	
<u>x</u>	Thermal treatment:		_ Condi	ıctive												
		<u>x</u>	Electr	ical R	esista	nce										
			C		3 ph	ase			6 phase			_AC power	r	DC	power	
			_ Steam		Stea	m		_	Steam +	- air	_	_ Steam + 0	02			_
			Other	(desc	ribe)											
<u>x</u>	Type of Test:	Pilot	test		<u>x</u>	Full	-scale	System								
<u>X</u>	Geology of Treatment Zone: Relativ				atively	/ homo	ogened	ous and	permeal	ble un	consolidat	ed sedir	nents			
				<u>X</u>	Rela	atively	/ homo	ogened	ous and	imperme	eable	unconsolic	lated se	diments		
					Larg	gely p	ermea	ıble se	diments	with inte	er-bed	ded lense	s of lowe	er permea	ability mater	ial
					Larg	gely in	nperm	eable	sedimer	nts with i	nter-b	edded laye	ers of hi	gher perr	neability ma	terial
					Con	npeter	nt, but	fractu	red bed	rock (i.e.	. cryst	alline rock)			
					Wea	athere	ed bed	rock, l	imeston	e, sands	tone					
<u>X</u>	Treatment Targe Zone:		Satur	ated	only		<u>X</u>	Vado	se only			Both (Sat	urated an	nd Vadose	zones)	
<u>x</u>	Start of Thermal Test:	6/25/	/2003						D	uration:	<u>751</u>					
<u>x</u>	Hydraulic Control		_Yes		<u>x</u>	No										
<u>x</u>	Treatment Cell Design:															
	Size of target zone (ft2):						3775	<u>50</u>				Unl	known	(_ x	ft)
	Thickness of target zone (ft):					<u>37</u>					Unl	known			
	Depth to top of target zone	(ft bg	s):				<u>3</u>					Unl	known			
	Thickness of target zone be	elow v	vater ta	able (1	ft):		0					Unl	known			
	Number of energy delivery	points	s:				<u>214</u>					Unl	known			
	Number of extraction points	S:					<u>214</u>					Unl	known			
<u>x</u>	Temperature Profile:															
	Initial formation temperature	e (deg	g C):						<u>13</u>					Unknown	1	
	Maximum representative fo	rmatio	on tem	perat	ure (deg C	;):		<u>95</u>					Unknown	1	
	Time to reach maximum rep	orese	ntative	temp	erati	ure (d	ays):							Unknown	1	
	Duration of treatment at rep	reser	ntative	temp	eratu	ıre (da	ays):							Unknown	ı	
										Date	<u>e</u>		<u>Te</u>	emperatu	re (deg C)	
	Formation temperature imm	nediat	tely pos	st-trea	atme	nt:										
	Formation temperature pos	t-trea	tment i	monit	oring	even	it 1:									
	Duration of post-treatment	monit	oring (days)	:											
	_ Mass of contaminant remov	/ed:														
	Via I	iquid	pumpir	ng:						_		_ lb			Un	known
	In va	por s	tream:									_ lb		kg	Un	known
	Tota	l:								_		_ lb		kg	Un	known
	Comments:															
	Treated 3	to 4	0 ft in	Area	s 1 a	nd 2,	, but o	only tre	eated 3	to 15 ft	in the	e Degreas	ser Area	<u>a.</u>		
	Attachments:															

Cost and Performance Facility ID#: 0415 Performance Remediation Goal: _ In Groundwater: -__ In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: ___ In Soil Comment: General comments on the thermal application: Lessons Learned Energy _ kWhr/yd³ ____ kWhr/m³ Total Energy Used: kWhr kWhr/yd³ 9015000 kwhr kWhr/m³ <u>x</u> Total energy applied to treatment zone: ___ Other energy: _ kWhr/m³ _ kWhr/yd³ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: __ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1: Other Cost 2:

Other Cost 3:

PD ____ File Analyzed By: Date: 9/13/2006 ____Steam ____Other: Type of treatment: Conductive Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating _Other: Treatment Status: ___ Active Post Type of Test: _ Pilot Test Full Scale System Start of Test: 6/4/1998 End of Test: 11/20/1998 Duration: 170 days Type of Site: Non-DOD __ DoD Facility Name: Former Electronics Manufacturing Address: Skokie, IL City, State, Zip Code: OU# or Site #: Primary point of contact: Bill Heath Organization: **CES** Address: 419 Entiat Street, Suite A City, State, Zip Code: Kennewick, WA 99336 Phone #: 509-727-4276 email: bill@cesiweb.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0420

General Site Information

___ Hydraulic Conductivity information

x Impacted			Width (ft): _	Thick	ness (ft):		<u>X</u> Unknown					
		Impacted zone as defined by documentation										
		rnative method for determining size of impacted zone (See source zone definition attachments)										
	Map attachment	Map attachment										
<u>x</u> Monitor V	Vells: Number of relevant m	Number of relevant monitoring wells with groundwater data:										
	Number of wells relat	tive to treatment zone:										
	Pre-treatment	In:	Upgradient:	ssgradient:								
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:						
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:									
	Number of relevant so	oil borings with post-treatmen	t data:									
	Number inside treatme	ent zone:	Number outsi	de treatment zone:								
x Types of C	Contaminants					I						
				Average Pre-treatme	nt Concentration per nical:		ent Concentration per nical:					
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)					
	x Trichloroethene	Hexane	Creosote	10 mg/L	None	0.1 mg/L	None					
	Tetrachloroethene	Jet Fuel		None	None	None	None					
	1,1-dichloroethene	Napthalene		None	None	None	None					
	x cis-1,2-dichloroethene	Benzene		10 mg/L	None	1 mg/L	None					
	trans-1,2-dichloroethene	Tolune		None	None	None	None					
	1,1-dichloroethane	Ethylbenzene		None	None	None	None					
	1,2-dichloroethane	m/p-xylene		None	None	None	None					
Chemicals of	x 1,1,1-trichloroethane	o-xylene		10 mg/L	None	0.1 mg/L	None					
Concern	1,1,2-trichloroethane			None	None	None	None					
	1,1,2,2-tetrachloroethane			None	None	None	None					
	Vinyl Chloride			None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
Comme	ents:	<u> </u>			·	<u>-</u>						
				·								
Attachmer	nts:	<u> </u>			·	<u>-</u>	·					
	-											

Facility ID#:

0420

General Site Assessment Data

Hydr	rogeologic Conceptual	Model		Facility ID#: 0420
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated set Relatively homogeneous and impermeable unconsolidated set Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated set Relatively homogeneous and impermeable unconsolidated set Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments over permeability material higher permeability material diments sediments over permeability material
<u>x</u>	Ground surface eleva	tion based on wells in o	adjacent to treatment zone: ft amsl	<u>x</u> Unknown
X	Aquifer Characteristic Is more than 1 aquifer		No Yes (number): <u>x</u> Ur Aquifer 1 Aquifer 2 Aquifer 3	nknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	7	-
	Flow direction			
X	Horizontal hydraulic g	,		<u>X</u> Unknown <u>X</u> Unknown
X	K range (ft/day)	Measured low high	0.028	Field data Unknown
	Transmissivity (ft2/da	y): Measured low high	sing: Slug Test Laboratory	
	Comments:			

K = 10 - 5 to 10 - 4 cm/sec

The	rmal Treatment - Design							F	acility ID#:	042	0
<u>x</u>	Thermal treatment:		_ Conductiv	/e							
		<u>x</u>	Electrical	Resistance							
				_ 3 phase	<u>x</u>	6 phase	AC	C power	D	C power	r
			_ Steam								
			_	Steam	_	Steam + air	Ste	eam + O2			
		_	Other (des	scribe)							
<u>x</u>	Type of Test:	_ Pilo	t test	<u>x</u> Full-	-scale Syst	em					
<u>x</u>	Geology of Treatment Zone	е:		_ Relatively	homoge	neous and per	meable uncon	solidated	sediments		
				_ Relatively	homoge	neous and imp	ermeable unc	onsolidate	d sediments		
			<u>x</u>			sediments wit			-	-	
						ole sediments v			of higher per	meabili	ity material
				_		ctured bedrock		e rock)			
						k, limestone, s					
<u>X</u>	Treatment Targe Zone:	<u>X</u>	Saturated	d only	V	adose only	·		ed and Vados	e zones))
<u>X</u>	Start of Thermal Test:		1998 V			Dura	tion: 170 days				
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No							
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):				23,000			Unkno	wn (_ x	ft)
	Thickness of target zone (f	t):			<u>19</u>		_	Unkno	wn		
	Depth to top of target zone	(ft bo	gs):		<u>5</u>			Unkno	wn		
	Thickness of target zone be	elow	water table	(ft):	<u>17</u>			Unkno	wn		
	Number of energy delivery points:				107		_	Unkno	wn		
	Number of extraction points	s:			<u>37</u>		_	Unkno	wn		
<u>x</u>	Temperature Profile:										
_	Initial formation temperatur	e (de	a C):			<u>10</u>			Unknow	n	
	Maximum representative for			ature (deg C	s):	100		_	Unknow		
	Time to reach maximum re		•			<u>60</u>		_	Unknow		
	Duration of treatment at rep				• /	70			Unknow		
							<u>Date</u>		Temperati	ure (de	g C)
	Formation temperature imr	nedia	tely post-tr	eatment:							
	Formation temperature pos	st-trea	atment mor	itoring even	t 1:						
	Duration of post-treatment	moni	toring (days	s):							
<u>x</u>	Mass of contaminant remo	ved:									
	Via I	liquid	pumping:				lb	_	kg	<u>x</u>	Unknown
	In va	apor s	stream:				lb	_	kg	<u>x</u>	Unknown
	Tota	al:					lb	_	kgkg	<u>x</u>	Unknown
	Comments:										
								_			
	Attachments:										

Cost and Performance				Facility ID#:	0420
Performance					
Remediation Goal:					
In Groundwate	r: —				
In Soil:					
Was the Remediation Goal Achieved					
In Groundwate					
Commer	t:				
In Soil	-				
Commer	t:				
General comments on the thermal ap	plication:				
Lessons Learned					
Energy					
Total Energy Used:	<u>1,775,000</u>	v 1/W/hr	kWhr/m ³	kW	/br/vd ³
Total Energy Osed. Total energy applied	· · · · · · · · · · · · · · · · · · ·	<u>x</u> kWhr		kWhr/m ³	kWhr/yd ³
Other energy:	to treatment zone.			_ kWhr/m ³	kWhr/yd ³
	ase note other energy:			_ KVVIII/III	KVVIII/yd
FIE	ase note other energy.				
<u>x</u> Cost					
Total Project Cost:	32/yd3				
Consultant Cost:					
Thermal Vendor Co	st:				
<u>x</u> Energy Cost:	148000		_ m³	_ yd³	
Other Cost 1:					
Other Cost 2:					
Other Cost 3:					
Please note other cost:	Other Cost 1:				
	Other Cost 2:				

____ Other Cost 3:

PD ____ File Analyzed By: Date: 9/13/2006 ____Steam ____Other: Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating _Other: Treatment Status: ___ Active Post X Type of Test: _ Pilot Test Full Scale System Start of Test: 12/1/1998 End of Test: 4/30/1999 Duration: _____ Type of Site: Non-DOD __ DoD Facility Name: Former Electronics Manufacturing Address: City, State, Zip Code: Skokie, IL OU# or Site #: Primary point of contact: Bill Heath Organization: **CES** Address: 419 Entiat Street, Suite A City, State, Zip Code: Kennewick, WA 99336 Phone #: 509-727-4276 email: bill@cesiweb.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: Address: _ City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0420

General Site Information

<u>x</u> Impacted		w direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>X</u> Unknown							
		od for determining size of im	neeted zone (See source -	zono definition attachmen	uto)									
	Alternative metri	-	pacied zone (See Source 2	zone definition attachmen	iis)									
	Map attacriment													
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy	vater data:				None							
WOULD V	voils.	normaning wens with grounds	Pre-treatment	+	Post-treatment:		None							
	Number of wells relat	tive to treatment zone:	T TO GOGGINO											
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:								
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:								
Soil Boring	gs: Number of relevant so	Number of relevant soil borings with pre-treatment data:												
		Number of relevant soil borings with post-treatment data:												
	Number inside treatme	ent zone:	Number outside	de treatment zone:										
x Types of C	Contaminants													
				Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:							
_	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)							
	x Trichloroethene	Hexane	Creosote	1 mg/L	None	0.1 mg/L	None							
	Tetrachloroethene	Jet Fuel		None	None	None	None							
	1,1-dichloroethene	Napthalene		None	None	None	None							
	x cis-1,2-dichloroethene	Benzene		1 mg/L	None	0.1 mg/L	None							
	trans-1,2-dichloroethene	Tolune		None	None	None	None							
	1,1-dichloroethane	Ethylbenzene		None	None	None	None							
	1,2-dichloroethane	m/p-xylene		None	None	None	None							
Ohilf	x 1,1,1-trichloroethane	o-xylene		0.01 mg/L	None	0.001 mg/L	None							
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None							
	1,1,2,2-tetrachloroethane			None	None	None	None							
	Vinyl Chloride			None	None	None	None							
				None	None	None	None							
				None	None	None	None							
				None	None	None	None							
				None	None	None	None							
				None	None	None	None							
				None	None	None	None							
Comme	ents:													
			<u> </u>											
Attachmer	nts:													
	-													

0420

General Site Assessment Data

Hydı	rogeologic Conceptual	Model		Facility ID#: 0420
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated and sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated and sediments with inter-bedded lenses of Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	d sediments lower permeability material of higher permeability material sediments d sediments lower permeability material
<u>x</u>	Ground surface eleva	tion based on wells in o	adjacent to treatment zone: ft amsl	<u>x</u> Unknown
X	Aquifer Characteristic Is more than 1 aquifer Depth to water:	r present?	No Yes (number): x Aquifer 1 Aquifer 2 Aquifer 3 Z	Unknown (assume single aquifer)
	_Flow direction	high value (ft bgs): Unknown:		_ _ _
<u>X</u>	Horizontal hydraulic g			<u>x</u> Unknown <u>x</u> Unknown
X	K range (ft/day)	Measured low high	sing: Slug Test Laboratory 0.028 0.28	Field data Unknown
	Transmissivity (ft2/dag	y): Measured low high	sing: Slug Test Laboratory	Field data <u>X</u> Unknown
	Comments:			

K = 10 - 5 to 10 - 4 cm/sec

The	ermal Treatment - Design									Facility ID#:	042	<u>00</u>
<u>x</u>	Thermal treatment:		_ Conduc	ctive _								
		<u>x</u>	Electric	cal Resistance								
			-	3 phase		<u>x</u> 6 j	ohase	A	C power	D	C powe	r
			_ Steam									
			-	Steam		St	eam + air	S	team + O	2		
			_ Other (describe)								
<u>x</u>	Type of Test:	_ Pilo	t test	<u>x</u> Fu	ull-scale S	ystem						
<u>x</u>	Geology of Treatment Zon	e:	-	Relative	ely homo	geneous	and permea	ible uncoi	nsolidate	d sediments		
			-	Relative	ely homo	geneous	and imperm	eable un	consolida	ited sediments		
			<u>></u>	<u>Largely</u>	permeab	le sedin	nents with int	er-bedde	d lenses	of lower perme	eability	material
			-	Largely	imperme	able sed	diments with	inter-bed	ded layeı	rs of higher per	rmeabil	ity material
			-	Compet	tent, but f	ractured	bedrock (i.e	. crystalli	ne rock)			
			-	Weathe	ered bedro	ock, lime	stone, sands	stone				
<u>X</u>	Treatment Targe Zone:	<u>x</u>	Satura	ted only		Vadose o	only	B	oth (Satu	rated and Vados	e zones)
<u>X</u>	Start of Thermal Test:	12/1	/1998				Duration:	18 weel	ks			
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No	О							
<u>x</u>	Treatment Cell Design:											
	Size of target zone (ft2):							<u>x</u>	Unkı	nown (_	x	ft)
	Thickness of target zone (f	t):						<u>x</u>	Unkı	nown		
	Depth to top of target zone	(ft bo	gs):					<u>x</u>	Unkı	nown		
	Thickness of target zone b	elow	water tal	ole (ft):				<u>x</u>	Unkı	nown		
	Number of energy delive		is:		185			_	Unkı	nown		
	Number of extraction point	s:			<u>37</u>			_	Unkı	nown		
<u>x</u>	Temperature Profile:											
	Initial formation temperatur	re (de	g C):			10				Unknow	'n	
	Maximum representative for	ormat	ion temp	erature (deg	(C):	10	0			Unknow	'n	
	Time to reach maximum re	prese	entative t	emperature	(days):	<u>60</u>				Unknow	'n	
	Duration of treatment at re	prese	ntative to	emperature ((days):	<u>70</u>				Unknow	'n	
							<u>Dat</u>	<u>te</u>		<u>Temperat</u>	ure (de	g C)
	Formation temperature imr	nedia	itely post	-treatment:								
	Formation temperature pos	st-trea	atment m	onitoring eve	ent 1:	_						
	Duration of post-treatment	moni	toring (d	ays):		_			_			
<u>x</u>	Mass of contaminant remo	ved:										
_	Via	liquid	pumping	g: _				1)	kg	<u>x</u>	Unknown
	In va	apor s	stream:	_				11		kg	<u>x</u>	Unknown
	Tota			_				11		kg	×	Unknown
	Comments:											
									_			
	Attachments:											

Cos	st and Performance					Facility ID#:	<u>0420</u>
	Performance						
	Remediation Goal:						
		In Groundwater: -					
	·						
		In Soil:					
	Was the Remediation	on Goal Achieved:					
		In Groundwater					
		Comment: -					
	_	In Soil					
		Comment: —					
		_					
	General comments	on the thermal applica	ation:				
	_						
	Lessons Learned						
	_						
_	_ Energy				3		3
	Total Energy Used:			kWhr	kWhr/m ³		
		tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd ³
	Oth	ner energy:	_			_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
<u>x</u>	Cost						
_	Total Project Cost:	\$	632/cubic yard				
	•	nsultant Cost:	<u>, , , , , , , , , , , , , , , , , , , </u>				
		ermal Vendor Cost:					
		ergy Cost:	-		_ m³	_ yd³	
		ner Cost 1:				_ ,~	
		ner Cost 1:					
	· 	ner Cost 3:	Other Coot 4:				
	Please note of	inei cost:	Other Cost 1:				
		_	Other Cost 2:				

____ Other Cost 3:

File Analyzed By: PD ____ Date: 11/1/2006 Type of treatment: Conductive __Steam ERH ____Other: <u>X</u> Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Pesticides _Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: _ Pilot Test Full Scale System Х Start of Test: 5/23/2006 End of Test: 10/4/2006 Duration: 134 days Type of Site: ___ Non-DOD DoD <u>X</u> Facility Name: Naval Station Great Lakes Address: Decauter Ave City, State, Zip Code: Great Lakes, IL 60088 OU# or Site #: Site 22 Primary point of contact: **Bob Davis** Organization: Tetra Tech Address: 661 Andersen Dr., Foster Plaza 7 City, State, Zip Code: Pittsburgh, PA 15220 Phone #: 412-921-7251 email: robert.davis@ttnus.com Other contacts or vendors who worked on site _ None Point of contact: David Fleming Type: Vendor, Consultant ___ Vendor, Technical Applications _ Other Organization: TRS Address: 7421-A Warren Ave SE City, State, Zip Code: Snoqualmie, WA 98065 Phone #: 425-396-4266 email: dfleming@thermalrs.com QA/QC Characteristics of Interest Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data \underline{X} Good temperature profile vs. time information Flux assessment Groundwater elevations Geologic cross-section

Facility ID#:

0423

General Site Information

G	General Site As	sessment [Data								Facility II	D#:	0423
X	(Impacted	Zone:	Length (parallel to flov		Width	(ft):	<u>30</u>	Thickness (ft):	8 to 20			_	Unknown
				as defined by documentation									
				od for determining size of in	npacted zone (Se	e source zor	ne definition atta	chments)					
			Map attachment										
X	Monitor V	Vells:	Number of relevant m	nonitoring wells with ground								_	None
					Pre	e-treatment:	4	Post-treatmer	nt:	<u>3</u>			
				ive to treatment zone:									
			Pre-treatment	In: <u>4</u>	Upgradient:	2	Downgra			sgradient:	2		
			Post-treatment	In: <u>3</u>	Upgradient:	2	Downgra	dient: 2	Cross	sgradient:	<u>2</u>		
	Call Basis		North an of automost an	U banda na colita nan tanatanan		20							
X	Soil Boring	gs:		il borings with pre-treatmen		<u>20</u>							
				il borings with post-treatmen		<u>10</u>		10					
			Number inside treatme	ent zone: 10	Nur	nber outside	treatment zone:	<u>10</u>					
	T (C												
X	Types of C	ontaminar	its										
							Average Pre-	treatment Concentration	n per	Average			oncentration per
		~					0 1	Chemical:				mical:	0.37 (0.)
Г			lorinated Solvents	Petroleum Hydrocarbons	Othe	er .	Groundwater (n		Kg)	Groundwat	er (mg/L)		Soil (mg/kg)
			nloroethene	Hexane	Creosote	ļ	None	None	_	None			None
			nchloroethene	Jet Fuel			None	1,000 mg/kg	_	None			None
			lichloroethene	Napthalene			None	None	_	None			None
			,2-dichloroethene	Benzene			None	None		None			None
			-1,2-dichloroethene lichloroethane	Tolune Ethylbenzene			None	None None		None			None None
			lichloroethane				None None	None	_	None			
				m/p-xylene					_	None			None
	Chemicals of		-trichloroethane -trichloroethane	o-xylene			None None	None		None			None None
	Concern		,2-tetrachloroethane				None	None	_	None			None
									_				
		viny	l Chloride				None	None	_	None			None
							None	None None	_	None			None
							None None	None	_	None			None None
							None	None		None			None
							None	None	_				
							None	None	_	None			None None
L							None	None		None			None
	Comme	nts:											
		_											
	Attachmen	nts:											
		_											
		_											

		Vadose Zone:	Relativel	y homogeneous a	nd permeable u	nconsolidated sed	diments
			Relativel	y homogeneous a	nd impermeable	e unconsolidated s	sediments
			Largely p	permeable sedime	nts with inter-be	edded lenses of lo	wer permeability material
			x Largely i	mpermeable sedin	nents with inter-	bedded layers of	higher permeability material
			Compete	ent, but fractured b	edrock (i.e. crys	stalline rock)	
			Weather	ed bedrock, limest	one, sandstone		
		Saturated Zone:	Relativel	y homogeneous a	nd permeable u	nconsolidated sed	diments
			Relativel	y homogeneous a	nd impermeable	e unconsolidated s	sediments
			Largely p	permeable sedime	nts with inter-be	edded lenses of lo	wer permeability material
			<u>x</u> Largely in	mpermeable sedin	nents with inter-	bedded layers of	higher permeability material
				ent, but fractured b	edrock (i.e. crys	stalline rock)	
				ed bedrock, limest	, ,	•	
				,	,		
<u>X</u>	Ground surface elev	ration based on wells in	or adjacent to tre	eatment zone:	<u>600</u>	ft amsl	Unknown
<u>x</u>	Aquifer Characterist	ics:					
	Is more than 1 aquif	er present?	No	Yes (number):		Ur	nknown (assume single aquifer)
			Aquifer 1	Aq	uifer 2	Aquifer 3	
	Depth to water:	low value (ft bgs):	<u>5</u>				
		high value (ft bgs):	<u>10</u>				
		Unknown:					
<u>X</u>	Flow direction		southerly				
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):		<u>0.1</u>	_		Unknown
	Vertical hydraulic gra	adient (feet/foot):					Unknown
<u>x</u>	K range (ft/day)	Measure	ed using: <u>x</u>	Slug Test	Laborate	ory	Field data
		low	0.2				Unknown
		high					
	Transmissivity (ft2/d	ay): Measure	ed using:	Slug Test	Laborate	ory	Field data
		low					Unknown
		high					
	Comments:						
	_						
	=				_		
	Attachments:						
	_						

The	rmal Treatment - Design										Facility ID#:	04	23
<u>x</u>	Thermal treatment:		_ Condu	ctive	_								
		<u>x</u>	Electri	cal Re	sistanc	e							
				<u>X</u> 3	3 phase		6 pha	se		AC power	1	DC powe	er
		-	_ Steam	5	Steam		Steam	n + air		Steam + O	2		
			Other	(descri	ibe)								
<u>x</u>	Type of Test:	Pilot	test	2	<u>x</u> F	ull-scale S	System						
<u>x</u>	Geology of Treatment Zor	ne:	•		Relativ	ely homo	geneous an	d permeal	ble unc	onsolidate	ed sediments		
			-	1	Relativ	ely homo	geneous an	d imperme	eable u	nconsolida	ated sediment	ts	
				l	Largely	y permeal	ble sedimen	ts with inte	er-bedo	ded lenses	of lower pern	neability	material
			-	<u>X</u> I	Largely	/ imperme	eable sedim	ents with i	inter-be	edded laye	rs of higher po	ermeab	ility material
				<u> </u>	Compe	etent, but	fractured be	edrock (i.e.	. crysta	lline rock)			
				\	Weath	ered bedi	ock, limesto	ne, sands	stone				
<u>X</u>	Treatment Targe Zone:		_ Satura	ated o	nly		Vadose only	/	<u>x</u>	Both (Satu	rated and Vado	ose zone	s)
<u>X</u>	Start of Thermal Test:	5/23	/2006					Duration:	134 d	<u>ays</u>			
<u>X</u>	Hydraulic Control		_ Yes	<u> </u>	<u>X</u> N	lo							
<u>x</u>	Treatment Cell Design:												
	Size of target zone (ft2):					<u>2400</u>				Unk	nown (.	:	x ft)
	Thickness of target zone ((ft):				16.58	<u>3</u>			Unk	nown		
	Depth to top of target zon	e (ft bg	ıs):			0.5				Unk	nown		
	Thickness of target zone I	oelow v	water ta	ble (ft)):	<u>12</u>				Unk	nown		
	Number of energy delivery	y points	S:			<u>16</u>				Unk	nown		
	Number of extraction poin	ts:				<u>16</u>				Unk	nown		
<u>x</u>	Temperature Profile:												
	Initial formation temperatu	ıre (de	g C):				<u>15</u>				Unkno	wn	
	Maximum representative	formati	on temp	eratu	re (de	g C):	<u>100</u>				Unkno	wn	
	Time to reach maximum r	eprese	ntative	tempe	erature	(days):	<u>30</u>				Unkno	wn	
	Duration of treatment at re	epresei	ntative t	empe	rature	(days):	<u>104</u>				Unkno	wn	
								<u>Dat</u>	<u>e</u>		Tempera	ature (de	eg C)
	Formation temperature im	media	tely pos	t-treat	tment:						<u>100</u>		
	Formation temperature po	st-trea	itment n	nonito	ring ev	ent 1:					N/A		
	Duration of post-treatmen	t monit	oring (d	ays):							<u>N/A</u>		
<u>x</u>	Mass of contaminant remo	oved:											
	Via	liquid	pumpin	g:	-					lb	kg	_	Unknown
	Inv	apor s	tream:		-				###	lb	kg	_	Unknown
	Tot	al:			-				<u>###</u>	lb	kg		Unknown
	Comments:												
	<u>Volume</u>	treate	d - 140	0 yd3	<u>3</u>								
	Attachments:												

Cost and Performance Facility ID#: 0423

<u>x</u>	Performance						
	Remediation Goal:						
	In Groundwater: -						
	-						
	<u>x</u> In Soil:						
			PCE <20 mg/k	g or 98.6% reduc	<u>ction</u>		
	Was the Remediation Goal Achieved:						
	Comment: -						
	-						
	<u>X</u> In Soil						
	Comment:						
	<u> </u>	PCE <4 mg/kg, 99% redu	<u>uction</u>				
	General comments on the thermal applic	cation:					
							
	Lessons Learned						
	Clay soils (low permeabil	lity soils) - should consid	der additional vap	or recovery wells			
	_						
<u>x</u>	Energy				2		
	Total Energy Used:		<u>x</u> kWhr			_ kWhr/yd ³	
	Total energy applied to	treatment zone:	<u>632,866</u>	_	kWhr/m ³		
	Other energy:	_			kWhr/m ³		kWhr/yd ³
	Please	e note other energy:					
<u>X</u>	Cost						
	Total Project Cost:						
	X Consultant Cost:	<u>360000</u>					
	x Thermal Vendor Cost:	<u>446000</u>					
	Energy Cost:			m ³	yd³		
	Other Cost 1:						
	Other Cost 2:						
	Other Cost 3:						
	Please note other cost:	Other Cost 1:					
	-	Other Cost 2:					
		Other Cost 3:					

General Site Information Facility ID#: 0425 File Analyzed By: PD ____ Date: 10/16/2006 Type of treatment: Conductive ____ Steam ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: Pilot Test Full Scale System Start of Test: 9/22/2004 End of Test: 11/1/2004 Duration: 56 d Type of Site: Non-DOD _ DoD Facility Name: Confidential IL Address: City, State, Zip Code: Olney, IL OU# or Site #: Primary point of contact: Waye Sheu Organization: Malcolm Pirnie Address: City, State, Zip Code: Chicago, IL Phone #: 847-517-8114 ext 103 email: wsheu@pirnie.com Other contacts or vendors who worked on site _None Point of contact: Type: Vendor, Consultant _____ Vendor, Technical Applications __Other Organization: TRS Address: City, State, Zip Code: Phone #: email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

(General Site Ass	sessment	Data					Facility I	D#:	0425				
2	Impacted 2	Zone:	Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u>	Unknown				
			Impacted zone a	s defined by documentation										
			Alternative meth	od for determining size of im	pacted zone (See source	zone definition attachmer	nts)							
			Map attachment											
>	Monitor W	Vells:	Number of relevant m	nonitoring wells with grounds	vater data:				<u>x</u>	None				
					Pre-treatme	nt:	Post-treatment: _							
			Number of wells relat	ive to treatment zone:										
	Pre-treatment In: Upgradient: Downgradient: Crossgradient:													
			Post-treatment	In:	Upgradient:	ossgradient:								
>	Soil Boring	js:	Number of relevant so	il borings with pre-treatment	data:	1								
	_			il borings with post-treatmer		2								
			Number inside treatme	ent zone: 1/2	Number outs	side treatment zone:	0/ 0							
	Number inside deathert zone. 172 Number obside deathert zone. Wo													
>	Types of C	Contaminar	nts											
						Average Pre-treatme	ent Concentration per nical:	Average Post-treatn	nent C mical:					
		Ch	lorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)				
Γ			hloroethene	Hexane	Creosote	None	5,000 mg/kg	None	0	.01 mg/kg				
			achloroethene	Jet Fuel		None	None	None		None				
			dichloroethene	Napthalene		None	None	None		None				
			1,2-dichloroethene	Benzene		None	None	None	Т	None				
		trans-1,2-dichloroethene		Tolune		None	None	None	Т	None				
			dichloroethane	Ethylbenzene		None	None	None		None				
			dichloroethane	m/p-xylene		None	None	None		None				
			1-trichloroethane	o-xylene		None	None	None		None				
	Chemicals of		2-trichloroethane	o-xylene		None	None	None		None				
	Concern		2,2-tetrachloroethane			None	None	None		None				
			yl Chloride					None	_					
		vin	yi Chioride			None	None		_	None				
						None	None	None		None				
						None	None	None	_	None				
						None	None	None	_	None				
						None	None	None	+	None				
						None	None	None	-	None				
L						None	None	None		None				
	Comments:													
						Area 1								
						Mod 1								
	Attachmen	ıts:												
	, maoninen													
		_												

(General Site Ass	sessment Data					Facility I	D#:	0425					
2	x Impacted 2	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u>	Unknown					
		Impacted zone a	as defined by documentation											
		Alternative method	od for determining size of im	pacted zone (See source zo	ne definition attachmer	nts)								
		Map attachment												
	Monitor Wells: Number of relevant monitoring wells with groundwater data:													
-	Monitor W			None										
	Number of wells relative to treatment zone:													
Pre-treatment In: Upgradient: Downgradient: Crossgradient:														
	Post-treatment In: Upgradient: Downgradient: Crossgradient:													
														
2	X Soil Borings: Number of relevant soil borings with pre-treatment data: 3													
	Number of relevant soil borings with post-treatment data: 2													
	Number inside treatment zone: $3/2$ Number outside treatment zone: $9/0$													
2	x Types of C	ontaminants	<u> </u>	T .	T		T							
	Average Pre-treatment Concentration per Average Post-treatment Concentration per													
					Cher	nical:	Che	mical:						
г		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)					
		x Trichloroethene	Hexane	Creosote	None	10,000 mg/kg	None	0.0	01 mg/kg					
		Tetrachloroethene	Jet Fuel		None	None	None	-	None					
		1,1-dichloroethene	Napthalene		None	None	None		None					
		cis-1,2-dichloroethene	Benzene		None	None	None	-	None					
		trans-1,2-dichloroethene	Tolune		None	None	None	-	None					
		1,1-dichloroethane	Ethylbenzene		None	None	None		None					
		1,2-dichloroethane	m/p-xylene		None	None	None		None					
	Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	-	None					
	Concern	1,1,2-trichloroethane			None	None	None	-	None					
		1,1,2,2-tetrachloroethane			None	None	None	-	None					
		Vinyl Chloride			None	None	None	-	None					
					None	None	None		None					
					None	None	None		None					
					None	None	None		None					
					None	None	None		None					
					None	None	None	-	None					
L					None	None	None		None					
	Commer	oto:												
	Continue	its.												
					Area 2									
				*	1104 2									
	Attachmen	te:												
	, macinilen													
		-												
		-												

Hyd	rogeologic Conceptual I	Model		Facility ID#	: 0425
X	Geology:	Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of lov Largely impermeable sediments with inter-bedded layers of h Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of lov Largely impermeable sediments with inter-bedded layers of h Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ediments ver permeabilit nigher permeal iments ediments ver permeabilit	bility material
<u>x</u>	Ground surface eleva	tion based on wells in or	r adjacent to treatment zone: ft amsl	<u>x</u>	Unknown
X	Aquifer Characteristic Is more than 1 aquifer Depth to water:	present?	No Yes (number): X Unl Aquifer 1 Aquifer 2 Aquifer 3 20	known (assume	single aquifer)
	_Flow direction				
<u>x</u>	Horizontal hydraulic g			_	Unknown Unknown
x	K range (ft/day)	Measured of low high		_	Unknown
	Transmissivity (ft2/day	y): Measured of low high	using: Slug Test Laboratory	_ Field data <u>X</u>	Unknown

Comments:

Attachments:

Very tight soils

10 foot spacing

The	rmal Treatment - Design								Facility ID#	<u>0425</u>
<u>x</u>	Thermal treatment:		_ Conduc	etive						
		<u>x</u>	Electric	al Resistance	Area	<u>. 1</u>				
			-	3 phase		6 phase		AC pov	wer	DC power
			_ Steam							
			_	Steam		Steam +	air	Steam	+ O2	
				describe)						
<u>X</u>	Type of Test:		t test	_	ll-scale	•				
<u>x</u>	Geology of Treatment Z	one:							lated sediments	
			_		-	_	-		olidated sedimen	
			_						·	neability material
			<u>x</u>							ermeability material
			_			fractured bedro rock, limestone		-	UK)	
<u>x</u>	Treatment Targe Zone:		Saturat		<u>х</u>	Vadose only			Saturated and Vade	ose zones)
<u>x</u>	Start of Thermal Test:		_ Oatarat	ica only	^	•	ıration:		aturated and vad	ose zones)
<u>x</u>	Hydraulic Control	<u> </u>	Yes	No	,		ilation.	<u>50 day</u>		
_	,	_								
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				400			t	Jnknown (<u>20</u> x <u>20</u> ft)
	Thickness of target zone	e (ft):			<u>8</u>			t	Jnknown	
	Depth to top of target zo	ne (ft bg	js):		2			t	Jnknown	
	Thickness of target zone	e below v	water tab	ole (ft):	<u>0</u>			t	Jnknown	
	Number of energy delive	ery point	s:		<u>4</u>			[[]	Jnknown	
	Number of extraction po	ints:			1				Jnknown	
<u>x</u>	Temperature Profile:									
	Initial formation tempera	ture (de	g C):			<u>20</u>			Unkno	own
	Maximum representative	e formati	on tempe	erature (deg	C):	100			Unkno	own
	Time to reach maximum	represe	entative to	emperature (days):	<u>28</u>			Unkno	own
	Duration of treatment at	represe	ntative te	emperature (d	days):	<u>28</u>			Unkno	own
							<u>Date</u>		Tempera	ature (deg C)
	Formation temperature	immedia	tely post-	-treatment:						
	Formation temperature	post-trea	ıtment m	onitoring eve	nt 1:					
	Duration of post-treatme	ent monit	oring (da	ays):						
<u>x</u>	Mass of contaminant re	moved:								
	V	'ia liquid	pumping	j: _				lb	kg	Unknown
	Ir	n vapor s	stream:	_			_	lb	kg	Unknown
	Т	otal:				<u>690</u>		<u>x</u> lb	kg	Unknown
	Comments: 10 ft s	pacings	<u>-</u>							
	C	ontamin	ant rem	oval is from	both to	eatment zone	<u>s</u>			
	Attachments:									

The	rmal Treatment -	Design											F	acility ID#:	04	<u>25</u>
<u>x</u>	Thermal treatm	ent:	_	_ Cond	luctive	_										
			<u>x</u>	Elect	rical R	esistance	Area	12								
						3 phase			6 phase			AC po	wer	E	C pow	er
				_ Stean	n											
						Steam		:	Steam + ai	r		_ Steam	+ O2			
					r (desc	ribe)										
<u>X</u>	Type of Test:	-	Pilot	test		_		System								
<u>X</u>	Geology of Trea	atment Zone	:			Relativel		-								
								-		-				d sediments		
														lower perm	-	
					<u>x</u>		-						-	of higher pe	rmeab	ility material
						-			ed bedroo		-	alline ro	CK)			
	Tue observant Tour	7		Catu		='			nestone, s	sanus		D.d. (G	1 137 - 1 -		
<u>X</u>	Treatment Targ Start of Therma			_ Satu	rated	only	<u>X</u>	vados	e only	otion:			Saturate	d and Vado	se zone	s)
<u>X</u>	Hydraulic Conti			/2004 Yes		No			Dura	ation:	<u> 36 d</u>	ay				
<u>x</u>	riyuraulic Conti	ioi	<u>x</u>	168		No										
<u>x</u>	Treatment Cell	Design:														
_	Size of target z	one (ft2):					600						Unknow	/n (30	x <u>20</u> ft)
	Thickness of ta	rget zone (ft)):				<u>15</u>					1	Unknow	/n		
	Depth to top of	target zone	(ft bg	ıs):			<u>20</u>						Unknow	/n		
	Thickness of ta	rget zone be	low v	water t	able (ft):	<u>15</u>						Unknow	/n		
	Number of ene	rgy delivery p	points	s:			<u>8</u>						Unknow	/n		
	Number of extra	action points	:				<u>8</u>					1	Unknow	/n		
<u>x</u>	Temperature P	rofile:														
_	Initial formation		e (de	g C):				,	20				_	Unknov	vn	
	Maximum repre	esentative for	rmati	on ten	nperat	ure (deg (C):	9	<u>95</u>				_	Unknov	vn	
	Time to reach r	naximum rep	orese	ntative	e temp	perature (days):	4	48				_	Unknov	vn	
	Duration of trea	atment at rep	resei	ntative	temp	erature (d	days):	<u> </u>	8				_	Unknov	vn	
										Date	9			Tempera	ture (de	ea C)
	Formation temp	perature imm	nedia	tely po	st-trea	atment:					_					
	Formation temp						nt 1:									
	Duration of pos	t-treatment r	nonit	oring ((days)	:							_			
<u>x</u>	Mass of contan	ninant remov	ed:													
_		Via li	quid	pumpi	ng:					_		_lb	_	kg		Unknown
		In va	por s	tream	:							_ lb	_	kg		Unknown
		Total	:					<u>690</u>			<u>x</u>	lb		kg	_	Unknown
	Comments:	The two e		odes		the area spacings		en zon	es 1 and	2 are	inclu	ded in	this sh	neet becau	ise the	ey extend
		Conta	amin	ant re	mova	l is from	both to	reatme	nt zones							
	Attachments:															

Cost and Performance Facility ID#: 0425

<u>x</u>	Performance			
	Remediation Goal:			
	In Grounds	vater:		
	<u>x</u> In Soil:			
		IL EPA Csat =	= 4440.78 mg/kg and a site sp	pecific goal of 75.18 mg/kg
	Was the Remediation Goal Achie			
	In Ground	water		
	Com	ment:		
	<u>x</u> In Soil			
	Com	ment:		
		<u>yes</u>		
	General comments on the therma	al application:		
		п аррисацоп.		
				
				
	Lessons Learned			
<u>x</u>	Energy			
_	Total Energy Used:	<u>x</u>	kWhr kV	/hr/m ³ kWhr/yd ³
		olied to treatment zone:	<u> </u>	kWhr/m ³ kWhr/yd ³
	Other energy:			kWhr/m ³ kWhr/yd ³
		Diagon note other energy:		KWIII/JU
		Please note other energy:		
<u>x</u>	Cost			
	Total Project Cost:			
	Consultant Cost			
	<u>x</u> Thermal Vendor			
	Energy Cost:	202000	m³	yd³
	 •-		"	yu
	Other Cost 1:	-		
	Other Cost 2:	<u></u>		
	Other Cost 3:			
	Please note other cost:	Other Cost 1:		
		Other Cost 2:		
		Other Cost 3:		

File Analyzed By: PD ____ Date: 4/18/2005 Type of treatment: Conductive ____ Steam ____Other: ___ Pesticides Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: methylene chloride <u>X</u> Treatment Status: ___ Active Post X Type of Test: _ Pilot Test Full Scale System Start of Test: End of Test: <u>11/10/2000</u> 12/8/1999 Duration: 329 days Type of Site: Non-DOD __ DoD Facility Name: Avery Dennison Mfg. Facility Address: 2340 Ernie Krueger Circle City, State, Zip Code: Waukegan, IL OU# or Site #: Primary point of contact: Jennifer Seul Organization: IL EPA Address: City, State, Zip Code: Phone #: 217-785-9399 email: ____ Other contacts or vendors who worked on site ____ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0440

General Site Information

(General Site As	sessment Data					Facility II	D#: <u>0440</u>
2	<u>Impacted</u>	Zone: Length (parallel to flo	w direction)(ft.): below	Width (ft):	Thick	ness (ft):		Unknown
		<u>x</u> Impacted zone	as defined by documentation	1				
		Alternative met	hod for determining size of in	npacted zone (See source zo	ne definition attachmer	nts)		
		Map attachmen	nt					
_	Monitor V	Vells: Number of relevant	monitoring wells with ground	water data:				None
				Pre-treatment:		Post-treatment:		
		Number of wells rela	ative to treatment zone:					
		Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
		Post-treatment	t In:	Upgradient:	Downgradient:	Cros	ssgradient:	
>	Soil Boring	gs: Number of relevant s	oil borings with pre-treatmen	t data: <u>154</u>				
		Number of relevant s	oil borings with post-treatmen	nt data: <u>20</u>				
		Number inside treatm	nent zone: <u>105/20</u>	Number outside	treatment zone:	49/0		
>	Types of C	Contaminants						
					Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	o-xylene		None	None	None	None
	Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
		x Methylene chloride			None	1,000 mg/kg	None	1 mg/kg
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
		<u>-</u>						
	Comme	nts:						
				Impacted a	rea of 16,000 yd3			
	Attachmer	nts:						

Hyd	rogeologic Conceptual	Model		Facility ID#: 0440
<u>x</u>	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of the Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of the Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material higher permeability material diments sediments wer permeability material
<u>x</u>	Ground surface eleva	ation based on wells in o	or adjacent to treatment zone: 727 ft amsl	Unknown
<u>x</u>	Aquifer Characteristic			
	Is more than 1 aquife Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:		known (assume single aquifer)
<u>x</u>	Flow direction		<u>NW</u>	
X	Horizontal hydraulic gra	-	0.00328	Unknown
X	K range (ft/day) Transmissivity (ft2/day)	Measured low high ay): Measured low high		Field data X UnknownField data X Unknown

Comments:

The	rmal Treatment - Design							Facility ID#:	044	0
<u>x</u>	Thermal treatment:		_ Conductive							
		<u>x</u>	Electrical F	Resistance						
				3 phase		_ 6 phase	AC por	werD	C power	•
			_ Steam			G	G.	. 02		
			04 (1	Steam	-	_ Steam + air	Steam	+ 02		
.,	Turns of Took	Dile	Other (desc							
<u>x</u>	Type of Test:	_Pilot		_	-scale Syste		ahlaaanaalia			
<u>x</u>	Geology of Treatment Zone).			_	eous and perme				
			<u>x</u>	-	_	•		olidated sediments		
			-					ses of lower perm	-	
			-					ayers of higher pe	meabii	ty materiai
						tured bedrock (i.d limestone, sand		uk)		
v	Treatment Targe Zone:		Saturated		Vac			Saturated and Vados	a zanas)	
<u>X</u>	Start of Thermal Test:		_ Gataratea /1999	Offiny	vac	•	n: 329 days	aturated and vados	c zones)	
	Hydraulic Control	<u>X</u>	Yes	No		Duration	i. <u>329 days</u>			
<u>x</u>	Trydraulio Control	~	103	110						
<u>x</u>	Treatment Cell Design:									
_	Size of target zone (ft2):				24500			Jnknown (_	x	ft)
	Thickness of target zone (ft):						Jnknown		
	Depth to top of target zone	(ft bg	s):					Jnknown		
	Thickness of target zone be	elow v	vater table ((ft):			<u>x</u> t	Jnknown		
	Number of energy delivery	points	3:		<u>95</u>			Jnknown		
	Number of extraction points	S:			<u>39</u>			Jnknown		
<u>x</u>	Temperature Profile:	- (-1	0)			10		77.1		
	Initial formation temperature		-		٠.	<u>13</u>	90	Unknow		
	Maximum representative fo		•			west 90 / east	80	Unknow		
	Time to reach maximum rep				-	<u>288</u>		Unknow		
	Duration of treatment at rep	reser	itative temp	erature (da	ays):	<u>41</u>		Unknow	'n	
						<u>Da</u>	ate_	Temperat	ure (de	g C)
	Formation temperature imm	nediat	tely post-tre	atment:						
	Formation temperature pos	t-trea	tment moni	toring even	t 1:					
	Duration of post-treatment	monit	oring (days)):						
<u>x</u>	Mass of contaminant remov	/ed:								
_	Via I	iquid	pumping:				lb	kg	<u>x</u>	Unknown
			tream:				lb	kg	<u>_</u>	Unknown
	Tota						lb	kg	<u>x</u>	Unknown
	Comments									
	Comments:									
	Attachments:									
	Audoninello.									

Cos	st and Performance					Facility ID#:	<u>0440</u>
(Performance						
	Remediation Goal:	_					
		In Groundwater: -					
	<u>x</u>	In Soil:	<u>N</u>	Methylene chloride	e: unsaturated 24	mg/kg	saturated 2,00
			mg/kg				Saturateu 2,00
	W 4b Ddi-ti	an Carl Arbinard					
	Was the Remediation						
		In Groundwater Comment: -					
		Comment.					
	<u>x</u>	In Soil					
	<u>~</u>	Comment:					
			es, but note that none o	f the saturated so	nils were over 2 00	00 ma/ka in pre-t	reatment samples
		<u> </u>	50, 50, 110, 10, 110, 110, 110, 110, 110	o sataratou so		50 mg/ng pro 1	odanioni odinpioo
	General comments	on the thermal applica	ation:				
	Had to extend	the time from 25 wee	eks to 47 weeks becaus	e of differences in	soil heating vers	us modelled hea	tina
							<u>a</u>
	Lessons Learned						
	_ Energy						
	Total Energy Used:			kWhr	kWhr/m ³		/hr/yd ³
	To	tal energy applied to t	reatment zone:			kWhr/m ³	kWhr/yd ³
	Ot	her energy:	_			kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
	_ Cost						
	Total Project Cost:						
		onsultant Cost:					
	Th	ermal Vendor Cost:	-				
	En	ergy Cost:			m ³	yd ³	
	Ot	her Cost 1:					
	Ot	her Cost 2:					
	Ot	her Cost 3:					
	Please note o	ther cost:	Other Cost 1:				
			Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u>	PD						Date:	10/18/2006
	Type of treatment:		_Conductive		_Steam	<u>x</u>	ERH	Other:		
	Type of Contaminant:	<u>x</u>	Chlorinated Sol	vents		Petr	oleum Hydroca	arbons	Pesticides	
			_Wood Treating			Oth	er:			
	Treatment Status:		_Active	<u>x</u>	Post					
	Type of Test:		_Pilot Test	<u>x</u>	Full Scale	e Syste	m			
	Start of Test:	7/9/2	<u> 2005</u>		End	of Tes	t: <u>20-Dec</u>		Duration: 164	<u>d</u>
	Type of Site:	<u>x</u>	Non-DOD	_	_DoD					
<u>x</u>	Facility Name: Former Sto	eel Ma	unufacturing Facil	ity						
	Address:									
	City, State, Zip Code:	Fort	Wayne, IN							
	OU# or Site #:									
<u>X</u>	Primary point of contact:	Jon	Hacker							
	Organization: Ft. Wayne	Steel	Corp							
	Address:									
	City, State, Zip Code:									
	Phone #: <u>260-434-2850</u>				email: jha	cker@	valbruna.us			
<u>x</u>	Other contacts or vendors wh	no woi	ked on site			_	_ None			
	Point of contact: <u>Jeff</u>	Pope								
	Type: <u>x</u> Vendor, C	onsult	ant	Ven	dor, Techni	ical Ap	plications	Oth	ier	
	Organization: <u>Clayton G</u>	roup								
	Address: <u>3140 Finley Rd</u>									
	City, State, Zip Code:	Dow	ners Grove, IL 6	0515						
	Phone #: <u>630-795-3211</u>				email: jpo	oe@cla	ytongrp.com			
Q.	A/QC									
	_ Characteristics of Interest									
	Good pre- and post-tre	atmen	t groundwater dat	ta			_Good pre- ar	d post-treatme	nt soil data	
	Good temperature prof	ile vs.	time information				_Flux assessm	ient		
	Groundwater elevation	ıs					_ Geologic cro	ss-section		
	Hydraulic Conductivit	y info	rmation							

0445

General Site Information

						Facility I	D#: <u>0445</u>
Impacted Zone:	Length (parallel to flow	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
	- "	as defined by documentation			(-7-	_	
		nod for determining size of im		zone definition attachmer	nts)		
	Map attachment		ipacica zone (oce source	Zone deminion andomner	113)		
	Iviap attacriment	•					
_ Monitor Wells:	Number of relevant n	monitoring wells with grounds	vater data:				None
			Pre-treatmer	nt:	Post-treatment:		
	Number of wells related	tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
_ Soil Borings:	Number of relevant so	oil borings with pre-treatment	data:				
	Number of relevant so	oil borings with post-treatmer	nt data:				
	Number inside treatm	ent zone:	_ Number outs	ide treatment zone:			
Types of Contain	minants						
					ent Concentration per	Average Post-treatm	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Cher Groundwater (mg/L)	nical: Soil (mg/kg)	Cher Groundwater (mg/L)	nical: Soil (mg/kg
x	Trichloroethene	Hexane	Creosote	100 mg/L	5,000 mg/kg	50 mg/L	100 mg/kg
-	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
				None	None	None	None
	cis-1.2-dichloroethene	Benzene					
	cis-1,2-dichloroethene trans-1,2-dichloroethene	Benzene Tolune					
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	trans-1,2-dichloroethene 1,1-dichloroethane	Tolune Ethylbenzene		None None	None None	None None	None None
	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane	Tolune Ethylbenzene m/p-xylene		None None None	None None None	None None None	None None None
hemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane	Tolune Ethylbenzene		None None None	None None None	None None None	None None None
	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None			
hemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None None	None None None None None None	None None None None None None None	None None None None None None
hemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None None None	None None None None None None None None	None None None None None None None None	None None None None None None None
nemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None None None None	None None None None None None None None	None None None None None None None None	None None None None None None None None
nemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None None None None	None None None None None None None None	None None None None None None None None	None None None None None None None None
nemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None None None None	None None None None None None None None	None None None None None None None None	None None None None None None None None
hemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None None None None	None None None None None None None None	None None None None None None None None	None None None None None None None None
hemicals of	trans-1,2-dichloroethene 1,1-dichloroethane 1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2-trichloroethane	Tolune Ethylbenzene m/p-xylene		None None None None None None None None	None None None None None None None None	None None None None None None None None	None None None None None None None None

Hyd	rogeologic Conceptual	Model				Facility ID#:	0445					
<u>x</u>	Geology:	Zone	Unconsolidate	ed Sediments								
		Vadose Zone:	Relativel	y homogeneous and pern	neable unconsolidated se	diments						
			Relativel	y homogeneous and impe	ermeable unconsolidated	sediments						
			x Largely p	permeable sediments with	inter-bedded lenses of lo	ower permeability mate	erial					
			Largely in	mpermeable sediments w	vith inter-bedded layers of	higher permeability m	ıaterial					
			Compete	ent, but fractured bedrock	(i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone									
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments									
			Relativel	y homogeneous and impe	ermeable unconsolidated	sediments						
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material									
			Largely impermeable sediments with inter-bedded layers of higher permeability material									
			Compete	ent, but fractured bedrock	(i.e. crystalline rock)							
			Weather	ed bedrock, limestone, sa	andstone							
X	Aquifer Characteristi Is more than 1 aquife Depth to water:	low value (ft bgs):	No Aquifer 1 10 12	Yes (number):Aquifer 2	U U	inknown (assume single a	aquifer)					
	_ Flow direction	Unknown:			_	-						
	_ Horizontal hydraulic	gradient (feet/foot):			<u> </u>	Unknow	wn					
	Vertical hydraulic gra	adient (feet/foot):				Unknow	wn					
	_ K range (ft/day)	Measured .	using:	Slug Test	Laboratory	Field data						
		low				Unknow	wn					
	Transmissivity (ft2/da	•	using:		_	Field data						
		low high				Unknov	Wil					

Comments:

The	mal Treatment - D	Design							Facility ID#:	<u>0445</u>
<u>x</u>	Thermal treatme	nt:	_ Conductive	·						
		<u>x</u>	Electrical R	Resistance	Areas A, B	, and C				
				3 phase		6 phase		AC power	rDC	power
			_ Steam							
				Steam		_ Steam + air		Steam + C)2	
			_ Other (desc	cribe)						
<u>x</u>	Type of Test:	Pilo	t test	<u>x</u> Full-	-scale Systen	1				
	Geology of Treat	tment Zone:		Relatively	homogene	ous and permea	ble un	consolidate	ed sediments	
				Relatively	homogene	ous and imperm	eable ι	unconsolid	lated sediments	
			<u>x</u>	Largely p	ermeable se	ediments with int	er-bed	ded lenses	s of lower permea	bility material
			-	_Largely in	npermeable	sediments with	inter-b	edded laye	ers of higher pern	neability material
			-	Competer	nt, but fractu	ured bedrock (i.e	. crysta	alline rock))	
				_ Weathere	ed bedrock,	limestone, sands	stone			
<u>x</u>	Treatment Targe	Zone:	_ Saturated	only	Vade	ose only	<u>x</u>	Both (Sati	urated and Vadose	zones)
<u>x</u>	Start of Thermal	Test: <u>7/9/</u>	2005			Duration:	164 0	<u>1</u>		
	_ Hydraulic Contro	ol	_ Yes	No						
<u>x</u>	Treatment Cell D	Design:								
_	Size of target zo	ne (ft2):			12289			Unl	cnown (x ft)
	Thickness of targ	get zone (ft):			14 to 26			Unl	cnown	
	Depth to top of to		gs):		8			Unl	known	
	Thickness of targ	-		ft):	12 to 24			Unl	known	
	Number of energ	_			41			Unl	known	
	Number of extra				<u>39</u>			Unl	known	
	Tarana anatara Bar	-61								
<u>x</u>	Temperature Pro		O)-			10			77.1	
	Initial formation t				٠٠.	<u>13</u>			Unknown	
	Maximum repres		•			<u>90</u>			Unknown	
	Time to reach ma	-	-			<u>80</u>			Unknown	
	Duration of treat	ment at represe	ntative temp	erature (da	ays):				Unknown	
						<u>Dat</u>	te_		Temperatur	e (deg C)
	Formation temper	erature immedia	itely post-tre	atment:						
	Formation temper	erature post-trea	atment monit	toring even	it 1:					
	Duration of post-	treatment moni	toring (days)):						
<u>x</u>	Mass of contami	nant removed:								
^	Made of contains		pumping:					lh	kg	Unknow
		In vapor s						=	kg	Unknow
		Total:			2434	8	<u>x</u>	lb	kg	Unknow
					2.54	_	-	-		
	Comments:	<u> </u>		<u> 20 II</u>						Area B -
		2872 ft2 at 8 t	o 22 ft							Area C -
		1699 ft2 at 8 f	to 34 ft							
	Attachments:									

Cos	t and Performance					Facility ID#:	<u>0445</u>
<u>x</u>	Performance						
_	Remediation Goal:						
	<u>x</u>	In Groundwater:					
				90%	6 mass reduction		
	<u>x</u>	In Soil:					
				90% m	ass reduction		
	Was the Remediation						
	X	In Groundwater					
		Comment:					
		-	s - 93% reduction				
	<u>x</u>	In Soil					
		Comment:					
		<u>yes</u>	s - 93% reduction				
	General comments	on the thermal applicat	ion:				
	Lessons Learned						
<u>x</u>	Energy						
^	Total Energy Used:	1663351		<u>x</u> kWhr	kWhr/m ³	kW	/hr/vd ³
		tal energy applied to tre		<u>x</u>		kWhr/m ³	kWhr/yd ³
		ner energy:				kWhr/m³	kWhr/yd ³
	0		ote other energy:			_ KVVIII/III	KVVIII/yd
		Flease II	ote other energy.				
<u>x</u>	Cost						
	Total Project Cost:						
	Co	nsultant Cost:					
	<u>x</u> Th	ermal Vendor Cost:	435302				
	En	ergy Cost:			m ³	_ yd³	
	<u></u>	ner Cost 1:			•		
	·	ner Cost 2:					
		ner Cost 3:					
	Please note of		Other Cost 1:				
			Other Cost 2:				

__ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	9/13/2006
	Type of treatment:	x Conductive	Stear	nERH	Other:		
	Type of Contaminant:	<u>x</u> Chlorinated S	Solvents	Petroleum Hydr	ocarbons	Pesticides	
	•	Wood Treating	ng	Other:			
	Treatment Status:	Active	<u>x</u> Post				
	Type of Test:	Pilot Test	<u>x</u> Full S	Scale System			
	Start of Test:	<u>Jul-97</u>		End of Test: Dec-97		Duration: 60 d	<u>[</u>
	Type of Site:	<u>x</u> Non-DOD	DoD				
<u>x</u>	Facility Name: Former Pre	emix/EMS Facility					
	Address: 400 S. Brid	dge St.					
	City, State, Zip Code:	Portland, IN					
	OU# or Site #:						
<u>x</u>	Primary point of contact:	Ralph S. Baker, Ph	.D.				
_	Organization: <u>TerraTherra</u>	-					
	Address: 10 Stevens Road						
	City, State, Zip Code:	Fitchburg, MA 014	420				
	Phone #: <u>978-343-0300</u>	•		rbaker@terratherm.co	<u>om</u>		
	Other contacts or vendors wh			None			
		rge L. Stegemeier, Pl					
	Type:Vendor, Co		Vendor, Te	chnical Applications	<u>X</u> Otl	ner Shell tech	. contact
		neering, Inc.					
	Address: 5819 Queenslock						
	City, State, Zip Code:	Houston, TX 77096					
	Phone #: <u>713-245-7785</u>		email:	gstegemeier@shell.co	<u>om</u>		
Q.	A/QC						
<u>x</u>	Characteristics of Interest						
	Good pre- and post-tre	atment groundwater	data	<u>x</u> Good pre-	- and post-treatme	nt soil data	
	<u>x</u> Good temperature prof	ile vs. time informati	ion	Flux asses	ssment		
	Groundwater elevation	ıs		<u>x</u> Geologic	cross-section		
	x Hydraulic Conductivity	y information					

0450

General Site Information

	mpacted 2	Impacted zone a	w direction)(ft.): <u>150</u> as defined by documentation and for determining size of imp	Width (ft): pacted zone (See source zo		ness (ft): 7500 nts)		Unknown						
<u>x</u>	Monitor W	Vells: Number of relevant n	nonitoring wells with groundw	ater data:				x None						
				Pre-treatment:		Post-treatment:								
	Number of wells relative to treatment zone:													
	Pre-treatment In: Upgradient: Downgradient: Crossgradient:													
	Post-treatment In: Upgradient: Downgradient: Crossgradient:													
<u>x</u> 5	Soil Boring	s: Number of relevant so	oil borings with pre-treatment	data: <u>5</u>										
			Number of relevant soil borings with post-treatment data: 5											
		Number inside treatme			e treatment zone:									
			<u></u>		<u> </u>									
<u>x</u> T	ypes of C	Contaminants												
						ent Concentration per nical:		ent Concentration per nical:						
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)						
		x Trichloroethene	Hexane	Creosote	None	100 mg/kg	None	0.01 mg/kg						
		x Tetrachloroethene	Jet Fuel		None	1,000 mg/kg	None	0.1 mg/kg						
		1,1-dichloroethene	Napthalene		None	None	None	None						
		cis-1,2-dichloroethene	Benzene		None	None	None	None						
		trans-1,2-dichloroethene	Tolune		None	None	None	None						
		1,1-dichloroethane	Ethylbenzene		None	None	None	None						
		1,2-dichloroethane	m/p-xylene		None	None	None	None						
		1,1,1-trichloroethane	o-xylene		None	None	None	None						
	nicals of ncern	1,1,2-trichloroethane			None	None	None	None						
		1,1,2,2-tetrachloroethane			None	None	None	None						
		Vinyl Chloride			None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
Ą	Commer			<u>Larger</u> :	treatment area									

0450

General Site Assessment Data

Genera	al Site Ass	sessment Data					Facility I	D#: <u>0450</u>				
<u>x</u> Ir	mpacted 2	- "	v direction)(ft.): 30	Width (ft):	<u>20</u> Thick	ness (ft): <u>600</u>		Unknown				
	Alternative method for determining size of impacted zone (See source zone definition attachments)											
	Map attachment											
<u>x</u> Monitor Wells: Number of relevant monitoring wells with groundwater data:												
Pre-treatment: Post-treatment:												
	Number of wells relative to treatment zone:											
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ossgradient:					
		Post-treatment	In:	Upgradient:	Downgradient:	Cro	ossgradient:					
s	oil Boring	s: Number of relevant so	il borings with pre-treatment	data:								
		Number of relevant so	il borings with post-treatmen	nt data:								
		Number inside treatme	ent zone:	Number outside	treatment zone:							
<u>x</u> T	ypes of C	Contaminants		T	T.		T					
					Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:				
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
		Trichloroethene	Hexane	Creosote	None	None	None	None				
		Tetrachloroethene	Jet Fuel		None	None	None	None				
		x 1,1-dichloroethene	Napthalene		None	0.5 mg/kg	None	0.05 mg/kg				
		cis-1,2-dichloroethene	Benzene		None	None	None	None				
		trans-1,2-dichloroethene	Tolune		None	None	None	None				
		1,1-dichloroethane	Ethylbenzene		None	None	None	None				
		1,2-dichloroethane	m/p-xylene		None	None	None	None				
01	nicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None				
	ncern	1,1,2-trichloroethane			None	None	None	None				
		1,1,2,2-tetrachloroethane			None	None	None	None				
		Vinyl Chloride			None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
	Comme	nts:										
				<u>Smaller</u> t	treatment area							
A	ttachmen	its:										

Hydr	rogeologic Conceptual	Model		Facility ID#:	<u>0450</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low xx Largely impermeable sediments with inter-bedded layers of I Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of low xx Largely impermeable sediments with inter-bedded layers of I Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ediments ver permeability material nigher permeability mater iments ediments ver permeability material	ial
<u>x</u>	Ground surface eleva	ation based on wells in o	adjacent to treatment zone: ft amsl	<u>x</u> Unknown	
<u>x</u>	Aquifer Characteristic Is more than 1 aquife Depth to water:		No Yes (number): X Un Aquifer 1 Aquifer 2 Aquifer 3 22	known (assume single aquif	fer)
	_Flow direction	Onknown.			
X	Horizontal hydraulic governical hydraulic grad	,		<u>x</u> Unknown<u>x</u> Unknown	
<u>X</u>	K range (ft/day) Transmissivity (ft2/da	Measured low high Measured low low	1.42(10 -5) 7.09 (10 -5)	Field data Unknown Field data Unknown	
	Comments:	high		<u>A</u> CHAROWI	

k = 0.005 to 0.025 millidarcy

Electrical Resistance 3 phase	The	rmal Treatment - Design						Faci	lity ID#:	0450	<u>)</u>
Steam Steam Steam Steam + air Steam + O2	<u>x</u>	Thermal treatment:	=	<u>-</u>	reatment	zone					
Steam Steam + air						_ 6 phase	AC pow	er	DC	power	
Type of Test:Pilot lest Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Both (Saturated and Vadose zones) Start of Thermal Test: Yes No Both (Saturated and Vadose zones) Yes No						_ Steam + air	Steam +	O2		-	
Geology of Treatment Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely premeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock, (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Treatment Targe Zone: Saturated only X Vadose only Both (Saturated and Vadose zones) X Stant of Thermal Test: July 1 Duration: Size of target Zone (ft2): Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (ft bgs): Depth to top of target zone (ft bgs): Depth to top of target zone (ft bgs): Depth to port arget zone below water table (ft): Number of extraction points: I 30 Unknown Number of extraction points: I 30 Unknown Number of extraction points: I 30 Unknown Time to reach maximum representative temperature (deg C): Maximum representative formation temperature (days): Maximum representative formation temperature (days): Duration of treatment at representative temperature (days): Duration of treatment at representative temperature (days): Well spacing of 7.5 ft (triangular).	v	Type of Test:	 -	_	le Systen	1					
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Start of Thermal Test: Jul-97 Duration: 63.d Hydraulic Control X Yes No Treatment Cell Design: Size of target zone (It2): 7500 Unknown (150 x 50 ft) Thickness of target zone (It2): 18 Unknown Depth to top of target zone (bys): 0 Unknown Number of energy delivery points: 130 Unknown Number of energy delivery points: 130 Unknown Time to reach maximum representative temperature (deg C): 2500 Unknown Duration of treatment at representative temperature (days): 0 Unknown Duration of treatment at representative temperature (days): 0 Unknown Duration of post-treatment monitoring event 1: Jun-98 37 Duration of post-treatment monitoring (days): 0 Unknown Well spacing of 7.5 ft (triangular).	~			_	•		ble unconsolida	ted sed	iments		
Largely permeable sediments with inter-bedded lenses of lower permeability material k Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Well spacing of 7.5 ft (triangular). Largely impermeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Largely permeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Well spacing of 7.5 ft (triangular). Largely premeable sediments with inter-bedded layers of higher permeability material Largely permeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fracture bedseck (i.e. crystalline rock) Largely premeable sediments with inter-bedded layers of higher permeability material Competent bedseck (i.e. crystalline rock) Largely presentative tends of competents of said substallance of said said substallance of said substa				_	-	•					
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones) X Start of Thermal Test: 1919 Duration: 63:d X Start of Thermal Test: 1919 Duration: 63:d X Treatment Cell Design: Size of larget zone (ft2): 7500 Unknown (150 _x _50 ft) Thickness of target zone (ft8ps): 0 Unknown Depth to top of target zone (ft9ps): Unknown Number of energy delivery points: 130 Unknown Number of extraction points: 130 Unknown Number of extraction points: 130 Unknown X Temperature Profile:				_	•	•				ability r	naterial
Weathered bedrock, limestone, sandstone			<u>x</u>						-	-	
X Treatment Targe Zone:Saturated only _X Vadose onlyBoth (Saturated and Vadose zones) X Start of Thermal Test:Jul-97				_ Competent, b	out fractu	ured bedrock (i.e.	. crystalline rocl	()			
Start of Thermal Test: 101-97				_ Weathered be	edrock,	limestone, sands	tone				
Yes No No Yes No No Yes Yes No Yes Yes No Yes Yes No Yes Yes Yes No Yes	<u>x</u>	Treatment Targe Zone	: Saturated	d only <u>x</u>	Vado	ose only	Both (Sa	turated a	and Vadose	zones)	
X Treatment Cell Design: Size of target zone (ft2): 7500Unknown (150 x 50 ft) Thickness of target zone (ft): 18Unknown Depth to top of target zone (ft bgs): 0Unknown Thickness of target zone below water table (ft): 0Unknown Number of energy delivery points: 130Unknown Number of extraction points: 130Unknown Number of extraction points: 130Unknown X Temperature Profile: Initial formation temperature (deg C): 260Uknown Time to reach maximum representative temperature (days): 63Unknown Duration of treatment at representative temperature (days):	<u>x</u>	Start of Thermal Test:	<u>Jul-97</u>			Duration:	<u>63 d</u>				
Size of target zone (ft2): 7500	<u>x</u>	Hydraulic Control	<u>x</u> Yes	No							
Thickness of target zone (ft): Depth to top of target zone (ft bgs): Depth to top of target zone below water table (ft): Depth to top of target zone below water table (ft): Number of energy delivery points: 130 Unknown Number of extraction points: 130 Unknown Number of extraction points: Initial formation temperature (deg C): Maximum representative formation temperature (deg C): Time to reach maximum representative temperature (days): Duration of treatment at representative temperature (days): Duration of treatment at representative temperature (days): Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Ibkg	<u>x</u>	Treatment Cell Design	:								
Depth to top of target zone (ft bgs): Thickness of target zone below water table (ft): Number of energy delivery points: 130 Number of extraction points: 130 Unknown Number of extraction points: 130 Unknown Unknown Unknown Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (days): Duration of treatment at representative temperature (days): Duration of treatment at representative temperature (days): Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: In vapor strea		Size of target zone (ft2	?):	<u>75</u>	<u> 600</u>		Uı	nknown	(<u>1</u>	<u>50</u> x	<u>50</u> ft)
Thickness of target zone below water table (ft): 0		_			3		· · · · · · · · · · · · · · · · · · ·				
Number of energy delivery points: 130 Unknown Number of extraction points: 130 Unknown X Temperature Profile: Initial formation temperature (deg C): X Unknown Maximum representative formation temperature (deg C): ≥260 Unknown Time to reach maximum representative temperature (days): 63 Unknown Duration of treatment at representative temperature (days): X Unknown Formation temperature immediately post-treatment: —				-							
Number of extraction points: 130Unknown X Temperature Profile: Initial formation temperature (deg C):		_					· · · · · · · · · · · · · · · · · · ·				
Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (deg C): Time to reach maximum representative temperature (days): Duration of treatment at representative temperature (days): Duration temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Well spacing of 7.5 ft (triangular).							· · · · · · · · · · · · · · · · · · ·				
Initial formation temperature (deg C): Maximum representative formation temperature (deg C): Time to reach maximum representative temperature (days): Duration of treatment at representative temperature (days): Date Temperature (deg C) Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: In vapor stream: Total: Well spacing of 7.5 ft (triangular).		Number of extraction p	points:	<u>13</u>	<u>80</u>		Uı	ıknown			
Maximum representative formation temperature (deg C): 2560	<u>x</u>	Temperature Profile:									
Time to reach maximum representative temperature (days): Duration of treatment at representative temperature (days): Date Temperature (deq C) Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Well spacing of 7.5 ft (triangular)		Initial formation temper	rature (deg C):					<u>x</u>	Unknowi	ı	
Duration of treatment at representative temperature (days): Date Temperature (deg C)		Maximum representati	ve formation tempera	ature (deg C):		<u>>260</u>			Unknowi	ı	
Date Temperature (deg C)		Time to reach maximum	m representative tem	perature (days)):	<u>63</u>			Unknowi	ı	
Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Well spacing of 7.5 ft (triangular)		Duration of treatment a	at representative tem	perature (days)	:			<u>x</u>	Unknowi	ı	
Formation temperature post-treatment monitoring event 1: Jun-98 Duration of post-treatment monitoring (days):						Date	<u>e</u>	1	- emperatu	re (deg	<u>ı C)</u>
		•				-					
Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Well spacing of 7.5 ft (triangular)			•	-		<u>Jun-98</u>		<u><37</u>			
Via liquid pumping: lb kg Unknown In vapor stream: lb kg Unknown Total: lb		Duration of post-freatif	ieni monitoring (days	·).							
In vapor stream:	<u>x</u>	Mass of contaminant re	emoved:								
Total:lbkg <u>x</u> Unknown Comments: Well spacing of 7.5 ft (triangular)			Via liquid pumping:				lb		_ kg	<u>x</u>	Unknown
Comments: Well spacing of 7.5 ft (triangular)			In vapor stream:				lb		_ kg	<u>x</u>	Unknown
Well spacing of 7.5 ft (triangular)			Total:				lb		_ kg	<u>x</u>	Unknown
		Comments:									
Attachments:		Well	spacing of 7.5 ft (tr	iangular)							
		Attachments:									

The	rmal Treatment - Design									Facilit	y ID#:	045	0
<u>x</u>	Thermal treatment:	<u>x</u>	Condu	ictive ical Resista		eatment are	<u>a</u>						
			Steam	3 pha		6 p	hase	AC	power		DO	power	
			-	Stear	n	Ste	am + air	Ste	am + O2				
<u>x</u>	Type of Test:	Pilot	_	<u>X</u>	Full-scale	System							
x	Geology of Treatment Zone			_		,	and permeal	ble uncons	olidated	sedim	ents		
_	<u> </u>				-	_	and imperm						
				Larg	ely perme	able sedim	ents with into	er-bedded	lenses o	of lowe	r perme	ability	material
				<u>x</u> Larg	ely impern	neable sed	iments with i	inter-bedde	ed layers	s of hig	her peri	meabili	ty material
				Com	petent, bu	t fractured	bedrock (i.e	. crystalline	e rock)				
				Wea	thered bed	drock, lime:	stone, sands	stone					
<u>x</u>	Treatment Targe Zone:		Satur	ated only	<u>x</u>	Vadose o	nly	Bot	th (Satura	ated and	l Vadose	zones)	
<u>x</u>	Start of Thermal Test:	1997					Duration:	<u>60 d</u>					
<u>x</u>	Hydraulic Control	<u>x</u>	Yes		_ No								
<u>x</u>	Treatment Cell Design:												
	Size of target zone (ft2):				<u>600</u>			_	Unkno	own	(<u>30</u> x	<u>20</u> ft)
	Thickness of target zone (f	t):			<u>12</u>				Unkne	own			
	Depth to top of target zone	(ft bgs	s):		<u>0</u>			_	Unkne	own			
	Thickness of target zone be	elow w	ater ta	able (ft):	<u>0</u>				Unkno	own			
	Number of energy delivery	points	::		<u>18</u>				Unkno	own			
	Number of extraction points	s:			<u>18</u>				Unkne	own			
	_ Temperature Profile:												
	Initial formation temperatur	e (deg	(C):						_	<u>x</u> 1	Unknowi	1	
	Maximum representative for	ormatio	on tem	perature (d	deg C):	>10	<u>00</u>				Unknowi	n	
	Time to reach maximum re	preser	ntative	temperatu	ıre (days):	<u>60</u>				<u>x</u> 1	Unknowi	n	
	Duration of treatment at rep	presen	tative	temperatu	re (days):				-	<u>x</u> 1	Unknowi	n	
	Formation temperature imr	mediat	elv nos	st-treatmer	nt·		<u>Dat</u>	<u>e</u>		Te	mperatu	ıre (de	<u>a C)</u>
	Formation temperature pos								-				
	Duration of post-treatment			_		_			-				
<u>x</u>	Mass of contaminant remo	ved:											
	Via I	liquid p	oumpir	ng:				lb		1	cg	<u>x</u>	Unknown
	In va	apor st	ream:					lb		1	cg	<u>x</u>	Unknown
	Tota	ıl:						lb		l	cg	<u>x</u>	Unknown
	Comments:												
	Attachments:												
													-

Cost and Performance Facility ID#: 0450

<u>x</u>	Performance						
	Remediation Goal:						
		_ In Groundwater:					
	<u>x</u>	In Soil:					
			PCE -	- 8 mg/kg; TCE - 25	mg/kg: 1,1-DCE	- 0.080 mg/kg	
	Was the Remediatio						
		_ In Groundwater					
		Comment:					
	<u>x</u>	In Soil					
		Comment:					
			Yes all reached in large	ger treatment area			
	General comments of	on the thermal appl	ication:				
	Lessons Learned						
	-						
	_ Energy						
	Total Energy Used:			kWhr	kWhr/m ³		
	Tota	al energy applied to	o treatment zone:			_ kWhr/m ³	kWhr/yd ³
	Oth	er energy:				_ kWhr/m ³	kWhr/yd ³
		Pleas	se note other energy:				
	_ Cost						
	Total Project Cost:			-			
		nsultant Cost:					
		ermal Vendor Cost:	-		_		
	Ene	ergy Cost:			m ³	yd ³	
	Oth	er Cost 1:					
	Oth	er Cost 2:					
	Oth	er Cost 3:					
	Please note otl	her cost:	Other Cost 1:				
			Other Cost 2:				
			Other Cost 3:				

Facility ID#: File Analyzed By: Date: PD ____ 10/18/2006 ____Steam Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: 2/14/2003 End of Test: 9/6/2003 Duration: 175 d Type of Site: Non-DOD __ DoD Facility Name: DOE Paducah Gaseous Diffusion Plant City, State, Zip Code: Paducah, KY (McCracken County) OU# or Site #: Primary point of contact: Bryan Clayton Organization: Bechtel-Jacobs Address: City, State, Zip Code: Phone #: <u>270-441-5412</u> email: btc@bechteljacobs.org Other contacts or vendors who worked on site ____ None & Point of contact: David Williams David Dollins _____ Vendor, Technical Applications Type: Vendor, Consultant Other EPA / DOE / DOE Organization: EPA Address: City, State, Zip Code: Phone #: 4045628554 / 2704416819 email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

0470

General Site Information

___ Hydraulic Conductivity information

G	eneral Site Ass	sessment	Data					Facility I	D#:	0470	
<u>x</u>	Impacted 2	Zone:	Length (parallel to flow	w direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u>	Unknown	
			Impacted zone a	as defined by documentation							
			Alternative meth	nod for determining size of im	pacted zone (See source zo	one definition attachmen	nts)				
			Map attachment	i .							
<u>X</u>	Monitor W	/ells:	Number of relevant n	nonitoring wells with ground					N	None	
					Pre-treatment:	4	Post-treatment:	<u>4</u>			
				tive to treatment zone:							
			Pre-treatment Post-treatment	In: <u>2</u> In: 2	Upgradient: <u>1</u> Upgradient: <u>1</u>	Downgradient: Downgradient:	_	ossgradient: 0			
			ossgradient: 0								
<u>X</u>	Soil Boring	js:		oil borings with pre-treatment							
				oil borings with post-treatmer							
			Number inside treatm	ent zone: 11/9	Number outsid	e treatment zone:	0/0				
X	Types of C	ontamina	nts								
Average Pre-treatment Concentration per Chemical: Average Post-treatment Concentration Chemical: Chemical:										centration per	
		Ct	nlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)	
Г			hloroethene	Hexane	Creosote	1,000 mg/L	100 mg/kg	5 mg/L		mg/kg	
			achloroethene	Jet Fuel	x Technitium-99	None	None	None		None	
			dichloroethene	Napthalene		None	None	None		None	
	<u>.</u>		1,2-dichloroethene	Benzene		None	None	None		None	
		Γ	s-1,2-dichloroethene	Tolune		None	None	None		None	
			dichloroethane	Ethylbenzene		None	None	None		None	
			dichloroethane	m/p-xylene		None	None	None		None	
			1-trichloroethane	o-xylene		None	None	None		None	
1	Chemicals of Concern		2-trichloroethane			None	None	None		None	
	001100111	1,1,;	2,2-tetrachloroethane			None	None	None	1	None	
		x Vin	yl Chloride			None	None	None	1	None	
						None	None	None	1	None	
						None	None	None	1	None	
						None	None	None	N	None	
						None	None	None	N	None	
						None	None	None	N	None	
						None	None	None	N	None	
	Comments:										
					Estimated 209,000 g	allons of TCE was rel	<u>eased</u>				
		_									
	Attachmen	its:									
		_									
		_									
					-		-				

X Geology: Zone Vadose Zone: Unconsolidated Sediments — Relatively homogeneous and permeable unconsolidated sediments — Relatively homogeneous and impermeable unconsolidated sediments — Relatively homogeneous and impermeable unconsolidated sediments — Largely permeable sediments with inter-bedded layers of higher permeability material — Competent, but fractured bedrock (i.e. crystalline rock) — Weathered bedrock, limestone, sandstone — Relatively homogeneous and permeable unconsolidated sediments — Relatively homogeneous and permeable unconsolidated sediments — Largely permeable sediments with inter-bedded layers of higher permeability material — Largely permeable sediments with inter-bedded layers of higher permeability material — Competent, but fractured bedrock, limestone, sandstone — Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: 370 ft amsl — Unknown X Aquifer Characteristics: Is more than 1 aquifer present? — No X Yes (number): — Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 — Unknown Depth to water: low value (ft bgs): 36 53 — — — — — — — — — — — — — — — — — — —	Hyd	rogeologic Conceptua	I Model				Facility ID#:	0470
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and impermeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Aquifer Characteristics: Is more than 1 aquifer present? No X Yes (number): JAquifer 1 Aquifer 2 Aquifer 3 Aquifer 1 Aquifer 3 Aquifer 2 Aquifer 3 Depth to water: Iow value (It bgs): 36 S3 High value (It bgs): 39 Unknown: X Flow direction X Unknown Y Horizontal hydraulic gradient (feet/foot): X Unknown Y K range (ft/day) Measured using: Slug Test Laboratory Field data Iow JUnknown Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Iow Unknown Junknown	<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Se	ediments_			
Largely permeable sediments with inter-bedded lenses of lower permeability material x Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock, (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely permeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock, (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: 370 ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No X Yes (number): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): 32 Unknown: X Flow direction X Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): X Unknown X K range (ft/day) Measured using: Slug Test Laboratory Field data low 1000 high 1000 High 1000 High 1000 Field data Nemanure Vinknown K Unknown Field data Nemanure Vinknown K Unknown K Unknown Field data Nemanure Laboratory Field data Nemanure Vinknown Field data Nemanure Vinknown Field data Nemanure Vinknown Field data Nemanure Vinknown Laboratory Field data Nemanure Vinknown Field data Nemanure Vinknown Field data Nemanure Vinknown Field data Nemanure Vinknown Laboratory Field data Nemanure Vinknown Field data Nemanure Vinknown Vertical hydraulic gradient (feet/foot): Sug Test Laboratory Field data			Vadose Zone:	Relatively ho	mogeneous and permeable	unconsolidated se	diments	
X Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and permeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: 370 ft amsl Unknown X Aquifer Characteristics: Is more than 1 aquifer present? No X Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): 36 53 high value (ft bgs): 39 Unknown: X Flow direction N Horizontal hydraulic gradient (feet/foot): N Vertical hydraulic gradient (feet/foot): N Neasured using: Slug Test Laboratory Field data low 1000 high 1000 Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data low 1000 high 1000 Yeltonown Yellonown Yellonow				Relatively ho	mogeneous and impermea	ble unconsolidated	sediments	
Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Weathered bedrock, limestone, sandstone Juliano Julian				Largely perm	neable sediments with inter-	bedded lenses of lo	wer permeability ma	terial
Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material X Largely impermeable unconsolidated sediments X Largely impermeable unconsolidated sediments X Largely impermeable unconsolidated sediments X Largely permeable unconsolidated lenses of higher permeable unconsolidated sediments X Largely permeable unconsolidated lenses of higher permeability material X Largely permeable unconsolidated lenses of higher permeability material X Largely permeable unconsolidated lenses of higher permeable unconsolidated lens				x Largely impe	rmeable sediments with inte	er-bedded layers of	higher permeability	material
Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely permeable sediments with inter-bedded lenses of higher permeability material X Largely permeable sediments with inter-bedded lenses of higher permeability material X Largely permeable sediments with inter-bedded lenses of higher permeability material X Largely permeable sediments with inter-bedded lenses of higher permeability material X Largely permeable sediments with inter-bedded lenses of higher permeability material X Largely permeable sediments with inter-bedded lenses of higher sediments				Competent, b	out fractured bedrock (i.e. c	rystalline rock)		
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: 370 ft amsl Unknown X Aquifer Characteristics: Is more than 1 aquifer present? No X _ Yes (number): Unknown (assume single aquifer) Aquifer 1				Weathered b	edrock, limestone, sandsto	ne		
Largely permeable sediments with inter-bedded lenses of lower permeability material x Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: 370 ft amsl Unknown X Aquifer Characteristics: Is more than 1 aquifer present? No X Yes (number): Unknown (assume single aquifer) Aquifer 1			Saturated Zone:	Relatively ho	mogeneous and permeable	unconsolidated se	diments	
X Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: 370 ft amsl Unknown X Aquifer Characteristics: Is more than 1 aquifer present? No X Yes (number): Unknown (assume single aquifer) Aquifer 1				Relatively ho	mogeneous and impermea	ble unconsolidated	sediments	
Competent, but fractured bedrock (i.e. crystalline rock)Weathered bedrock, limestone, sandstone X Ground surface elevation based on wells in or adjacent to treatment zone: 370 ft amslUnknown X Aquifer Characteristics: Is more than 1 aquifer present? NoXYes (number):Unknown (assume single aquifer) Aquifer 1				Largely perm	neable sediments with inter-	bedded lenses of lo	wer permeability ma	terial
				x Largely impe	rmeable sediments with inte	er-bedded layers of	higher permeability	material
Aquifer Characteristics: Is more than 1 aquifer present? No X Yes (number): Unknown (assume single aquifer) Aquifer 1				Competent, b	out fractured bedrock (i.e. c	rystalline rock)		
Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1				Weathered b	edrock, limestone, sandsto	ne		
X Unknown Vertical hydraulic gradient (feet/foot): X Unknown Y Unknown X Unknown Y K range (ft/day) Measured using: Slug Test Laboratory Field data Iow 100 Unknown high 1000 Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Iow Slug Test Laboratory Field data Iow Y Unknown	<u>x</u>	Is more than 1 aquif	low value (ft bgs): high value (ft bgs):	Aquifer 1 36	Aquifer 2		nknown (assume single	e aquifer)
X Unknown X Unknown X K range (ft/day) Measured using: Slug Test Laboratory Independent of the property of	<u>x</u>	Flow direction			_ <u>N</u>		-	
χ K range (ft/day) Measured using: Slug Test Laboratory Field data low 100	<u>x</u>	Horizontal hydraulic	gradient (feet/foot):				<u>x</u> Unkn	own
low		Vertical hydraulic gra	adient (feet/foot):				<u>x</u> Unkn	own
Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Laboratory	<u>x</u>	K range (ft/day)				atory		own
low <u>x</u> Unknown			high		-		_	
		Transmissivity (ft2/d	ay): Measure	d using: S	lug Test Labor	atory	Field data	
high			low				<u>x</u> Unkn	own
			high				-	

Comments:

The	rmal Treatment - Design								Facility ID#:	<u>0470</u>
<u>x</u>	Thermal treatment:	C	onductive							
		<u>x</u> El	lectrical Re	esistance						
				3 phase	<u>x</u>	6 phase		_ AC power	DC	power
		St	eam							
				Steam	_	Steam + air	r	_ Steam + O2	!	
		<u> </u>	ther (descr	ribe)						
<u>x</u>	Type of Test: <u>x</u>	Pilot tes	t	Full-	scale Syste	em				
<u>x</u>	Geology of Treatment Zone) :				eous and per				
				-	_	•			ted sediments	
									of lower perme	-
			_		-			-	s of higher perr	neability material
			·	-		tured bedroc , limestone, s		lailine rock)		
<u>x</u>	Treatment Targe Zone:	S				dose only	<u>X</u>	Roth (Satur	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	2/14/200		Jilly	va	-	<u>^</u> ation: <u>175</u>		ated and vadose	zones)
<u>x</u>	Hydraulic Control			No		24.0	<u> 175</u>	<u>u</u>		
-	,									
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>6825</u>			Unkn	own (<u>10</u>	<u>05</u> x <u>65</u> ft)
	Thickness of target zone (ft):			<u>95</u>			Unkn	own	
	Depth to top of target zone	(ft bgs):			<u>2</u>			Unkn	own	
	Thickness of target zone be	elow wate	er table (f	t):	<u>67</u>			Unkn	own	
	Number of energy delivery	points:			<u>6</u>			Unkn	own	
	Number of extraction points	s:			<u>6</u>			Unkn	own	
<u>x</u>	Temperature Profile:									
_	Initial formation temperature	e (deg C):			<u>20</u>			Unknown	ı
	Maximum representative fo	rmation	temperatu	ure (deg C):	<u>70</u>			Unknown	ı
	Time to reach maximum re	presenta	tive temp	erature (da	ays):	<u>112</u>			Unknown	ı
	Duration of treatment at rep	resentat	tive tempe	erature (da	ıys):	<u>63</u>			Unknown	ı
							Data		Tamananatu	70 (do 7 C)
	Formation temperature imm	nediately	nost-trea	itment:		9/5/2003	<u>Date</u>		Temperatu 91	re (deg C)
	Formation temperature pos	-			t 1:	10/29/2003			<u>58</u>	
	Duration of post-treatment			-						
<u>x</u>	Mass of contaminant remov	/ed:								
	Via I	iquid pur	nping:					_ lb	kg	Unknown
	In va	por strea	am:	_				_ lb	kg	Unknown
	Tota	l:			<u>103</u>	<u>877</u>		_ lb	<u>x</u> kg	Unknown
	Comments:									
	Attachments:									

Cos	t and Performance		Facility ID#: 0470
<u>x</u>	Performance		
	Remediation Goal:		
	<u>x</u>	In Groundwater:	
		RGA (~50-90') groundwater to less than 1% To	CE solubility (11000ppb)
	<u>x</u>	In Soil:	
		UCRS (0-50') to reduce TCE in soil	<u>by 75%</u>
	Was the Remediation	on Goal Achieved:	
	<u>x</u>	In Groundwater	
		Comment:	
		Yes a 99.1% reduction	
	<u>x</u>	In Soil	
		Comment:	
		Yes, a 98% reduction	
	General comments	on the thermal application:	
	Objective: To	demonstrate implementability of this technology in UCRS saturated and unsatu	rated soil and in RGA groundwater
	Lessons Learned		
	Lessons Learned		
	Electrodes car	n fail to heat at discrete depths if the steel shot displaces the electric insulating	(bentonite) materials making the
	electrode act a the formation.	as 1 continuous electrode which in turn may not have feed enough power to the	bottom of the electrode to heat up
	the formation.		
<u>x</u>	Energy		
	Total Energy Used:	<u>2283850</u> <u>x</u> kWhr <u></u> kWhr/m	kWhr/yd ³
	Tot	al energy applied to treatment zone:	kWhr/m ³ kWhr/yd ³
	Oth	ner energy:	kWhr/m ³ kWhr/yd ³
		Please note other energy:	
<u>x</u>	Cost		
	Total Project Cost:	6300000	
	Co	nsultant Cost:	
	The	ermal Vendor Cost:	
	En	ergy Cost: m ³	yd³
	Oth	ner Cost 1:	
	Oth	ner Cost 2:	
		ner Cost 3:	
	Please note ot	her cost: Other Cost 1:	
		Other Cost 2:	

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>x</u> PD				Date:	10/30/2006
	Type of treatment:	Conductive	Steam	ERH <u>x</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	<u>x</u> Chlorinated Solv	vents	Petroleum Hydrocarbo	ons	Pesticides	
		Wood Treating	_	Other:			
	Treatment Status:	<u>x</u> Active	Post				
	Type of Test:	Pilot Test	x Full Scale	System			
	Start of Test:	<u>1-Oct</u>	End	of Test:		Duration:	
	Type of Site:	<u>x</u> Non-DOD	DoD				
<u>x</u>	Facility Name: Confidenti	al; Boston, MA					
	Address:						_
	City, State, Zip Code:	Boston, MA					
	OU# or Site #:						_
<u>x</u>	Primary point of contact:	Karen Brody or	Joseph Fiacco				
	Organization: <u>ERM</u>						
	Address: 399 Boylston St.	, 6th Floor					
	City, State, Zip Code:	Boston, MA 02166					
	Phone #: <u>617-646-7800</u>		email: <u>Kar</u>	en.brody@erm.com			
<u>x</u>	Other contacts or vendors wh	no worked on site		None			
	Point of contact: Ray	Kasevich					
	Type: <u>x</u> Vendor, C	onsultant	_ Vendor, Techni	cal Applications	Othe	r	
	Organization: KSN Energ	gies					
	Address: 291 Main St., 31	rd Floor, PO Box 612					
	City, State, Zip Code:	Great Barrington, MA	01230				
	Phone #: 413-528-4651		email: rkas	sevich@ksnenergies.com	<u>!</u>		
Q	A/QC						
	_ Characteristics of Interest						
	Good pre- and post-tre	atment groundwater data	a	Good pre- and p	ost-treatment	soil data	
	Good temperature prof	file vs. time information		Flux assessment	:		
	Groundwater elevation	ıs		Geologic cross-s	section		
	Hydraulic Conductivity	y information					

0495

General Site Information

General Site A	ssessment Data					Facility II	D#: <u>0495</u>
Impacted	Impacted zone a	w direction)(ft.):			ness (ft):	_	Unknown
	Map attachment						
Monitor	Wells: Number of relevant n	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borir							
		oil borings with post-treatmer					
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
x Types of	Contaminants						_
				Average Pre-treatment Concentration per Chemical:			ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	x 1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comm	ents:						
					_		
Attachme	ents:						
	-						

Hyd	rogeologic Conceptu	ıal Model				Facility ID#:	0495
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated S	ediments_			
		Vadose Zone:	Relatively ho	mogeneous and	d permeable unconsolidat	ed sediments	
			Relatively ho	mogeneous and	d impermeable unconsolic	dated sediments	
			Largely perm	neable sediment	s with inter-bedded lense	s of lower permeability mate	rial
			Largely impe	rmeable sedime	ents with inter-bedded lay	ers of higher permeability m	aterial
			x Competent, I	out fractured be	drock (i.e. crystalline rock)	
			Weathered b	edrock, limesto	ne, sandstone		
		Saturated Zone:	Relatively ho	mogeneous and	d permeable unconsolidat	ed sediments	
			Relatively ho	mogeneous and	d impermeable unconsolid	dated sediments	
			Largely perm	neable sediment	s with inter-bedded lense	s of lower permeability mate	rial
			Largely impe	rmeable sedime	ents with inter-bedded lay	ers of higher permeability m	aterial
			x Competent, I	out fractured be	drock (i.e. crystalline rock)	
			Weathered b	edrock, limesto	ne, sandstone		
	_ Ground surface ele	evation based on wells in	or adjacent to treatm	ent zone:	ft amsl	Unknow	wn
	_ Aquifer Characteris						
	Is more than 1 aqu	ifer present?	_ No		_	Unknown (assume single a	iquiter)
	Donath to water	lavvialva (# h ma).	Aquifer 1	Aqui	fer 2 Aquife	i 3	
	Depth to water:	low value (ft bgs):					
		high value (ft bgs): Unknown:			<u></u>		
		OTIKITOWIT.		-			
	_ Flow direction						
							
	Horizontal hydrauli	c gradient (feet/foot):				Unknov	wn
	Vertical hydraulic g	, ,				Unknow	wn
	, ,						
	_ K range (ft/day)	Measure	d using: S	Slug Test	Laboratory	Field data	
		low				Unknow	wn
		high					
	Transmissivity (ft2/	day): Measure	d using: S	Slug Test	Laboratory	Field data	
		low	-			Unknow	wn
		high					
	Comments:						
	-						
	_						

The	rmal Treatment - Design				Facility ID#:	0495
<u>x</u>	Thermal treatment:	Conductive				
	_	Electrical Resistance				
		3 phase Steam	6 phase	AC power	DC	power
		Steam	Steam + air	Steam + C)2	
v	X Tune of Test:		RFH			
X	Type of Test: Pi Geology of Treatment Zone:	_	cale System	bla unaansalidate	ad codiments	
<u>X</u>	Geology of Treatment Zone.		nomogeneous and permean nomogeneous and imperm			
		-	meable sediments with in			hility material
			permeable sediments with		-	-
			, but fractured bedrock (i.e			ousinty material
			bedrock, limestone, sand			
	_ Treatment Targe Zone:		Vadose only		rated and Vadose:	zones)
	Start of Thermal Test:		Duration			
	_ Hydraulic Control	Yes No				
	_Treatment Cell Design:					
	Size of target zone (ft2):			Unk	nown (x ft)
	Thickness of target zone (ft):			Unk	known	
	Depth to top of target zone (ft	bgs):		Unk	nown	
	Thickness of target zone below	w water table (ft):		Unk	nown	
	Number of energy delivery poi	nts:		Unk	known	
	Number of extraction points:			Unk	cnown	
	_Temperature Profile:					
	Initial formation temperature (c	- '			Unknown	
	Maximum representative forma				Unknown	
	Time to reach maximum repre				Unknown	
	Duration of treatment at repres	sentative temperature (day	/s):		Unknown	
			Do	to	Temperatur	o (dog C)
	Formation temperature immed	liately post-treatment:	<u>Da</u>	<u>le</u>	remperatur	e (deg C)
	Formation temperature immed Formation temperature post-tro		 1·			
	Duration of post-treatment mo	_				
	Daration of poor trouting it	g (aayo).				
	_ Mass of contaminant removed	d:				
	_	id pumping:		lb	kg	Unknow
	In vapo	r stream:		lb	kg	Unknow
	Total:	<u> </u>		lb	kg	Unknow
					-	
	Comments:					
	Attachments:					
	-					

at and Performance					Facility ID#:	<u>0495</u>
_ Performance						
Remediation Goal:						
	In Groundwater: —					
	In Soil:					
Was the Remediation						
	In Groundwater					
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
						
Lessons Learned						
_ Energy						
Total Energy Used:			1/W/he	kWhr/m ³	3 H	Mbr/vd ³
	tal energy applied to to	rootmont zono:	KWIII		N kWhr/m³	kWhr/yd
		eatment zone:			kWhr/m³	
Oti	her energy:				KVVNr/m°	kWhr/yo
	Please	note other energy:				
_ Cost						
Total Project Cost:						
•	onsultant Cost:					
· 						
	ermal Vendor Cost: ergy Cost:			m ³	yd³	
' <u></u>	0,				yu	
	her Cost 1:	-				
	her Cost 2:					
	her Cost 3:					
Please note of	ther cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	7/26/2006
	Type of treatment:	Conductive		_ Steam	<u>x</u>	ERH	Other:		
	Type of Contaminant:	x Chlorinated Solv	ents		Petr	oleum Hydroc	arbons	Pesticides	
		Wood Treating			Oth	er:			
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	Pilot Test	<u>x</u>	Full Scal	le Syste	em			
	Start of Test:	7/31/2003		Enc	l of Tes	t: <u>9/22/2003</u>		Duration: 53 c	lays
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: Naval We	apons Industrial Reserve	Plant						
	Address:								_
	City, State, Zip Code:	Bedford, MA							
	OU# or Site #: Site 3								
<u>x</u>	Primary point of contact:	Maritza Montegross							
	Organization: Navy NAV	VFAC Mid-Atlantic							
	Address: 9742 Maryland	Ave.							
	City, State, Zip Code:	Norfok, VA 23511							
	Phone #: <u>757-444-5872</u>			email: ma	aritza.m	ontegross@na	vy.mil		
<u>x</u>	Other contacts or vendors wl	no worked on site				_ None			
	Point of contact: <u>Joe</u>	Francis							
	Type: <u>x</u> Vendor, C	onsultant	_Ven	dor, Techn	ical Ap	plications	Oth	ner	
	Organization: <u>TetraTech</u>								
	Address: 133 Federal St.,	6th Floor							
	City, State, Zip Code:	Boston, MA 02110							
	Phone #: 617-457-8409			email: jos	seph.fra	ncis@tteci.com	<u>n</u>		
Q/	A/QC								
<u>x</u>	Characteristics of Interest								
=		atment groundwater data	ı			Good pre- a	nd post-treatme	nt soil data	
		file vs. time information			<u>x</u>	Flux assessi	-		
	Groundwater elevation				_	_ Geologic cr			
	Hydraulic Conductivit					Č			

0500

General Site Information

General Site A	Assessment Data					Facility II	D#: <u>0500</u>					
Impacte	 ·	as defined by documentation	Width (ft): n npacted zone (See source zo		ness (ft):	_	Unknown					
	Map attachment		ipadicu zono (dee source zo	one definition attachmen	,							
<u>x</u> Monitor	r Wells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:	17	Post-treatment:	<u>17</u>	None					
	Number of wells relat	tive to treatment zone:										
	Pre-treatment	In: <u>7</u>	Upgradient: 2	Downgradient:	4 Cros	ssgradient: 4						
	Post-treatment	In: <u>17</u>	Upgradient:	Downgradient:	Cros	ssgradient:						
0 " 0 "												
x Soil Bori		oil borings with pre-treatment										
		oil borings with post-treatmer		tractment sens.								
	Number inside treatme	ent zone:	_ Number outside	e treatment zone:	 -							
w Types o	f Contaminants											
w Types o	Contaminants											
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatme Chen	ent Concentration per nical:					
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)					
	x Trichloroethene	Hexane	Creosote	10 mg/L	1 mg/kg	1 mg/L	None					
	x Tetrachloroethene	Jet Fuel		1 mg/L	0.5 mg/kg	0.05 mg/L	None					
	1,1-dichloroethene	Napthalene		None	None	None	None					
	x cis-1,2-dichloroethene	Benzene		1 mg/L	None	None	None					
	x trans-1,2-dichloroethene	Tolune		0.01 mg/L	None	None	None					
	x 1,1-dichloroethane	Ethylbenzene		1 mg/L	0.01 mg/kg	0.01 mg/L	None					
	1,2-dichloroethane	m/p-xylene		None	None	None	None					
01	x 1,1,1-trichloroethane	o-xylene		1 mg/L	0.01 mg/kg	0.01 mg/L	None					
Chemicals o Concern	1,1,2-trichloroethane			None	None	None	None					
	1,1,2,2-tetrachloroethane			None	None	None	None					
	Vinyl Chloride			None	None	None	None					
	x 1,2-DCE (total)			1 mg/L	0.5 mg/kg	0.5 mg/L	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
Comn	a a mto.											
Comm	nents.											
	data	<u>Pg</u>	29 - Pilot report (appendi	x A) for pre data and		ix D in Appendix A - S	Soils data					
	auu				<u>spona</u>	, , , , , , , , , , , , , , ,						
Attachm	ents:											

Hydrogeologic Conceptual Model Facility ID#: 0500 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone _ Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: __ ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): <u>15</u> high value (ft bgs): 30 Unknown: Flow direction WSW Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: _ Slug Test Field data Laboratory low 0.099 _ Unknown high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory Field data

Unknown

Comments:

Attachments:

K = 3.5e-5

cm/s_

No GW elevation data yet

low

high

The	rmal Treatment - De	esign						Facility ID#:	<u>0500</u>
<u>x</u>	Thermal treatment	t:	_ Conductiv	re					
		<u>x</u>	Electrical	Resistance					
				_ 3 phase	<u>x</u>	6 phase	AC power	er D0	C power
		_	Steam						
				_ Steam		_ Steam + air	Steam +	O2	
			_ Other (des						
<u>x</u>	Type of Test:	_	ot test	· · · · · · · · · · · · · · · · · · ·	-scale Syste		- -		
<u>x</u>	Geology of Treatm	nent Zone:	_		ū	•	eable unconsolida		
				-	_	•	meable unconsoli		
			<u>X</u>				nter-bedded lense	•	•
					-		.e. crystalline rock		meability material
			_	_		limestone, san	•	•)	
<u>x</u>	Treatment Targe 2	Zone: <u>x</u>	Saturated		Vac		Both (Sa	turated and Vados	e zones)
<u>x</u>	Start of Thermal T		1/2006	a only	vac	•	n: 53 days	artica ana vados	z zones)
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No		Durano	11. <u>55 days</u>		
_	,	_							
<u>x</u>	Treatment Cell De	sign:							
	Size of target zone	e (ft2):			3200		Un	known (40 x 80 ft)
	Thickness of targe	et zone (ft):			<u>35</u>		Un	known	
	Depth to top of tar	get zone (ft b	gs):		<u>20</u>		Un	known	
	Thickness of targe	t zone below	water table	(ft):	<u>35</u>		Un	known	
	Number of energy	delivery poin	ts:		<u>24</u>		Un	known	
	Number of extract	ion points:			<u>24</u>		Un	known	
<u>x</u>	Temperature Profi	le:							
	Initial formation te	mperature (de	eg C):			<u>13</u>		Unknow	n
	Maximum represe	ntative format	ion tempera	ature (deg C	;):	<u>95</u>		Unknow	n
	Time to reach max	kimum repres	entative tem	nperature (d	ays):	<u>38</u>		Unknow	n
	Duration of treatm	ent at represe	entative tem	perature (da	ays):	<u>15</u>		Unknow	n
						<u>D</u>	ate_	Temperatu	ure (deg C)
	Formation tempera	ature immedia	ately post-tre	eatment:					
	Formation tempera	ature post-tre	atment mon	itoring even	nt 1:				
	Duration of post-tr	eatment mon	toring (days	s):					
<u>x</u>	Mass of contamina	ant removed:							
		Via liquid	I pumping:				lb	kg	Unknown
		In vapor	stream:	_			lb	kg	Unknown
		Total:			<u>89.</u>	9	<u>x</u> lb	kg	Unknown
	Comments:								
		4 ft electrode pacing	<u>ə</u>						
	<u>-</u>	Total 112,	000 ft3						
	Attachments:								
	_								

Cos	st and Performance	e						Facility ID#:	<u>0500</u>
<u>x</u>	Performance								
_	Remediation Go	al:							
		x In Grou	ndwater:						-
		_		1. determine the pote source area	ential effec ; 2. 95% re	tiveness, i eduction in	mplementability, VOCs in pilot te	and xost of using st area; 3. develo	<u>ERH to treat entire</u> <u>p cost info</u>
		In Soil:							
	Was the Remed	iation Goal Acl	hieved:						
		x In Grou	ndwater						
		Co	mment:						
				No, cis-1,2-DCE went	way up				
		In Soil							
		Co	mment:						
	General comme	nts on the ther	mal appli	cation:					
		dropped in trea	tment zo	ne and contaminated 85% of tot					
	<u>area</u>			83 /8 OF LOD	ar energy	01 720391	KVVIII		
	Lessons Learne	d							
	Know litho	logy well when	designin	g an application					
<u>X</u>	Energy								
	Total Energy Us	ed:	61678	<u>36</u>	<u>x</u>	kWhr	kWhr/m		-
		Total energy	applied to	treatment zone:				kWhr/m ³	kWhr/yd ³
		Other energy:						kWhr/m ³	kWhr/yd ³
		_	Pleas	e note other energy:	_				_
	04								
	_ Cost	_4.							
	Total Project Co				-				
		Consultant Co				_			
		Thermal Vend	dor Cost:			_	2	2	
		Energy Cost:					m ³	yd³	
		Other Cost 1:		-		_			
		Other Cost 2:				_			
		Other Cost 3:				_			
	Please not	e other cost:		Other Cost 1:					
				Other Cost 2					

____ Other Cost 3: ___

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	7/26/2006
	Type of treatment:	Conductive		_ Steam	<u>x</u>	ERH	Other:		
	Type of Contaminant:	Chlorinated Solv	ents	<u>X</u>	Petroleum Hydrocarbo		carbons	Pesticides	3
	_	Wood Treating			Oth	er:			
	Treatment Status:	Active	<u>X</u>	Post					
	Type of Test:	Pilot Test	<u>X</u>	Full Scale	•				
	Start of Test:	7/31/2003			of Tes	t: <u>9/22/2003</u>		Duration: 53	<u>days</u>
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: Naval Wea	apons Industrial Reserve	Plant						
^	Address:	pons maustrar reserve	1 min						
	City, State, Zip Code:	Bedford, MA							
	OU# or Site #: Site 4								
<u>x</u>	Primary point of contact:	Maritza Montegross							
	Organization: Navy NAV	FAC Mid-Atlantic							
	Address: 9742 Maryland Ave.								
	City, State, Zip Code:	Norfolk, VA 23511							
	Phone #: <u>757-444-5872</u>			email: ma	ritza.m	ontegross@n	avy.mil		
<u>x</u>	Other contacts or vendors wh	no worked on site				_ None			
	Point of contact: <u>Joe I</u>	Francis .							
	Type: <u>x</u> Vendor, Co	onsultant	_Ven	dor, Techni	ical Ap	plications	Oth	ier	
	Organization: <u>TetraTech</u>								
	Address: 133 federal St., 6	oth Floor							
	City, State, Zip Code:	Boston, MA 02110							
	Phone #: <u>617-457-8409</u>			email: jos	eph.fra	ncis@tteci.co	<u>m</u>		
O	A/QC								
Q,	n QO								
<u>x</u>	Characteristics of Interest								
=		atment groundwater data	ı			Good pre-	and post-treatme	nt soil data	
		ïle vs. time information				_ Flux assess	•		
	Groundwater elevation						ross-section		
	 X Hydraulic Conductivity 					_			

<u>0501</u>

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0501</u>	
Impacted	Impacted zone	ow direction)(ft.): as defined by documentation hod for determining size of im tt	n		ness (ft):	_	Unknown	
<u>x</u> Monitor V	Vells: Number of relevant i	monitoring wells with ground					None	
	Number of wells rela Pre-treatment Post-treatment		Pre-treatment: Upgradient: Upgradient:	Downgradient: Downgradient:		9 ssgradient:ssgradient:		
X Soil Borings: Number of relevant soil borings with pre-treatment data: 1 Number of relevant soil borings with post-treatment data:								
				Average Pre-treatme	ent Concentration per nical:		nent Concentration per mical:	
-	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None	None	None	None	
	Tetrachloroethene	Jet Fuel		None	None	None	None	
	1,1-dichloroethene	x Napthalene		None	10 mg/kg	None	None	
	cis-1,2-dichloroethene	x Benzene		0.5 mg/L	None	0.005 mg/L	None	
	trans-1,2-dichloroethene	x Tolune		1 mg/L	10 mg/kg	0.5 mg/L	None	
	1,1-dichloroethane	x Ethylbenzene		5 mg/L	100 mg/kg	0.5 mg/L	None	
	1,2-dichloroethane						None	
		x m/p-xylene		1 mg/L	50 mg/kg	0.1 mg/L		
Chemicals of	1,1,1-trichloroethane	x o-xylene		1 mg/L	10 mg/kg	0.1 mg/L	None	
Concern	1,1,2-trichloroethane			None	None	None	None	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
Comme	19 in all soil samples baser		² ost-treatment GW data - p	g. 32 and pre-treatme	Soil samples or	nly have pre data and one was 50ft by 20ft I		

Hyd	drogeologic Conceptua	ıl Model		Facility ID#: 0501							
<u>x</u>	Geology:	Zone	<u>Unconsolidated Sediments</u>								
		Vadose Zone:	<u>x</u> Relatively homogeneous and permeable unconsolidated	sediments							
			Relatively homogeneous and impermeable unconsolidate	ed sediments							
			Largely permeable sediments with inter-bedded lenses of	f lower permeability material							
			Largely impermeable sediments with inter-bedded layers	of higher permeability material							
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated sediments								
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material								
			Largely impermeable sediments with inter-bedded layers of higher permeability material								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
X	Aquifer Characterist Is more than 1 aquif		No Yes (number): X Aquifer 1 Aquifer 2 Aquifer 3	Unknown (assume single aquifer)							
	Depth to water:	low value (ft bgs):	10.5	<u> </u>							
		high value (ft bgs):	20.5	_							
		Unknown:									
<u>x</u>	Flow direction		<u>NNW</u>	_							
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):		<u>x</u> Unknown							
	Vertical hydraulic gr	adient (feet/foot):		<u>x</u> Unknown							
x	K range (ft/day)	Measured	· — · .	Field data							
		low	0.0032	Unknown							
	Transmississis #10/3	high	0.0992	— Field Jee							
	Transmissivity (ft2/d		using: Slug Test Laboratory	Field data							
		low		<u>x</u> Unknown							

Comments:

K = 3.5e-5 cm/s to 11.2e-7

high

cm/s No GW elevation data yet

The	mal Treatment - I	Design								Faci	lity ID#:	<u>0501</u>	
<u>x</u>	Thermal treatme	ent:		_ Conductive	·								
		;	<u>x</u>	Electrical F	Resistance								
					3 phase	-	6 phase		AC po	wer	DO	C power	
				Steam									
					Steam	-	Steam + air		Steam	+ O2			
				Other (desc	cribe)								
<u>X</u>	Type of Test:	_	Pilot		Full	-							
<u>X</u>	Geology of Trea	tment Zone:		-	_	_	eneous and peri						
					-	_	eneous and imp						
				<u>X</u>			e sediments with				•	-	
							able sediments v				igher per	meability	material
					_		actured bedrock		-	CK)			
.,	Tuesday and Taur	- 7		Cotumated	_		ck, limestone, sa				137. 1		
<u>X</u>	Treatment Targe		<u>X</u>		Only		Vadose only			saturated a	na vados	e zones)	
<u>X</u>	Start of Thermal	•		<u>2006</u>	No		Dura	uon:	53 days				
<u>x</u>	Hydraulic Contro	UI .	<u>x</u>	Yes	No								
<u>x</u>	Treatment Cell [Design:											
-	Size of target zo	-				1000			ı	Jnknown	(20 x	50 ft)
	Thickness of tar		:			18.5				Jnknown	(<u></u> 10)
	Depth to top of t	-		s):		9.5			· <u></u>	Jnknown			
	Thickness of tar	-	_		(ft):	11			· <u></u>	Jnknown			
	Number of energ	_				8			· <u></u>	Jnknown			
	Number of extra					<u>8</u>				Jnknown			
<u>x</u>	Temperature Pro	ofile:											
	Initial formation	temperature	(deg	g C):			<u>14</u>				Unknow	n	
	Maximum repres	sentative for	matio	on tempera	ture (deg C	:):	<u>93</u>				Unknow	n	
	Time to reach m	naximum rep	rese	ntative temp	perature (d	ays):	<u>50</u>				Unknow	n	
	Duration of treat	tment at repr	eser	ntative temp	erature (da	ays):	<u>3</u>				Unknow	n	
								<u>Date</u>		I	emperatu	ure (deg (<u>C)</u>
	Formation temporary	erature imme	ediat	ely post-tre	atment:		9/22/2003			<u>92</u>			
	Formation temporary	erature post-	-trea	tment moni	toring even	nt 1:	-						
	Duration of post	-treatment m	nonit	oring (days)):								
<u>X</u>	Mass of contam												
				pumping:					lb		_		Unknow
				tream:					lb			·	Unknow
		Total:					<u>69.5</u>		<u>x</u> lb		_ kg		Unknow
	Commercia	10 11 515011	uuc	_									
	Comments:	spacing 6 month	hs o	f post-treat	tment								
		sampling			_							To	otal_
	Attachments:	19,425 ft3	or /	19 903									
	Attachments:												

Cost and Performance Facility ID#: 0501 Performance Remediation Goal: In Groundwater: Achieve site cleanup objective of 50 ppb benzene in GW In Soil: Was the Remediation Goal Achieved: x In Groundwater Comment: Yes, in treatment zone __ In Soil Comment: General comments on the thermal application: 23% of total 726,391 kWhr Lessons Learned Energy _ kWhr/yd³ ____ kWhr/m³ Total Energy Used: 167070 kWhr kWhr/yd3 __ Total energy applied to treatment zone: kWhr/m³ __ Other energy: kWhr/m³ _ kWhr/yd³ _ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ___ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3:

Other Cost 1:
Other Cost 2:
Other Cost 3:

Please note other cost:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	10/26/2006
	Type of treatment:	Conductive	x Steam	ERH	Other:		
	Type of Contaminant:	Chlorinated Sol	vents	Petroleum Hyd	rocarbons	Pesticides	3
		Wood Treating	<u>x</u>	Other: PC	<u>Bs</u>		
	Treatment Status:	Active	$\underline{\mathbf{x}}$ Post				
	Type of Test:	Pilot Test					
	Start of Test:	<u>14-Jun-01</u>	End	of Test:		_ Duration:	
	Type of Site:	<u>x</u> Non-DOD	DoD				
<u>x</u>	Facility Name: Metal Rec	ycling Facility (H. Cohe	en)				
	Address:						
	City, State, Zip Code:	Boston, MA					
	OU# or Site #:						
<u>x</u>	Primary point of contact:	Brian Coty					
	Organization: Shaw						
	Address: <u>88C Elm Street</u>						
	City, State, Zip Code:	Hopkinton, MA 0174	<u> 18-1656</u>				
	Phone #: <u>508-435-9561</u>		email: <u>bri</u>	an.coty@shawgrp.	com		
<u>x</u>	Other contacts or vendors w	ho worked on site		None			
	Point of contact: <u>Jay</u>	Dablow					
	Type: <u>x</u> Vendor, C	onsultant	Vendor, Techn	cal Applications	Otl	her	
	Organization: <u>ERM (for</u>	merly Shaw)					
	Address: <u>3 Hutton Centre</u>	Suite 600					
	City, State, Zip Code:	Santa Ana, CA 92707	<u>.</u> -				
	Phone #: <u>714-430-1476</u>		email: jay	dablow@erm.com			
_	A /O.O.						
Q	A/QC						
	_ Characteristics of Interest						
	Good pre- and post-tre	atment groundwater dat	ta	Good pre	- and post-treatme	ent soil data	
	Good temperature pro	file vs. time information	1	Flux asse	ssment		
	Groundwater elevation	ıs		Geologic	cross-section		
	Hydraulic Conductivit	y information					

0505

General Site Information

x Impacted Zone: Length (parallel to flow direction)(ft.): 125 Width (ft): 150 Thickness (ft): Unknown 1 \underline{x} Impacted zone as defined by documentation _ Alternative method for determining size of impacted zone (See source zone definition attachments) ____ Map attachment ___ Monitor Wells: Number of relevant monitoring wells with groundwater data: ____None Pre-treatment: Post-treatment: _ Number of wells relative to treatment zone: Upgradient: _____ Pre-treatment In: _____ Downgradient: ____ Crossgradient: Post-treatment In: _____ Upgradient: _____ Downgradient: _____ Crossgradient: ____ Soil Borings: Number of relevant soil borings with pre-treatment data: Number of relevant soil borings with post-treatment data: Number inside treatment zone: Number outside treatment zone: ____ Types of Contaminants Average Pre-treatment Concentration per Average Post-treatment Concentration per Chemical: Chemical: Chlorinated Solvents Other Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L) Soil (mg/kg) Petroleum Hydrocarbons Trichloroethene Hexane Creosote None None None None ___ Jet Fuel Tetrachloroethene None None None None 1,1-dichloroethene ___ Napthalene None None None None __ cis-1,2-dichloroethene Benzene None None None None __ trans-1,2-dichloroethene Tolune None None None None ___1,1-dichloroethane Ethylbenzene None None None None ____1,2-dichloroethane None ___ m/p-xylene None None None ___1,1,1-trichloroethane __o-xylene None None None None Chemicals of ___1,1,2-trichloroethane None None None None Concern __1,1,2,2-tetrachloroethane None None None None __ Vinyl Chloride None Comments: Attachments:

Facility ID#:

0505

General Site Assessment Data

Hyd	Irogeologic Conceptua	al Model					Facility ID#:	<u>0505</u>
x	Geology:	Zone Vadose Zone: Saturated Zone:	Relativel Largely i Largely i Compete Weather Relativel Relativel Largely i Largely i Compete	ly homogeneous a permeable sedime mpermeable sediment, but fractured bed bedrock, limes by homogeneous a permeable sediment, but fractured bedrock, but fractured bedrock, but fractured bedrock, but fractured bed bedrock, limes	and impermeable ents with inter-bed ments with inter-bed dedrock (i.e. cryst tone, sandstone and permeable urand impermeable ents with inter-bed ments with inter-bed ments with inter-bed dedrock (i.e. cryst	unconsolidated so dded lenses of low pedded layers of h talline rock) acconsolidated sedi unconsolidated so dded lenses of low pedded layers of h	ediments ver permeability n nigher permeabilit iments ediments ver permeability n	ry material
<u>×</u>	_ Ground surface elev	vation based on wells in o	r adjacent to tre	eatment zone:		ft amsl	Un	known
	Is more than 1 aquit	fer present?	No	Yes (number):		Unl	known (assume sin	gle aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 8 10	Aq	quifer 2	Aquifer 3		
_								
	_ Horizontal hydraulic Vertical hydraulic gr	gradient (feet/foot):						known known
<u>x</u>	K range (ft/day)	Measured low high	using: 0.011 0.36	Slug Test	Laborator	у	Field data	known
	Transmissivity (ft2/c	· ·		Slug Test	Laborator	у	Field data Unl	known
	Comments:							

The	rmal Treatment - Design							Facility ID#:	<u>0505</u>
<u>x</u>	Thermal treatment:		_ Conductiv	ve					
			_ Electrical	Resistance					
		<u>x</u>	Steam	3 phase	_	6 phase	AC pov	verD	C power
		Δ		Steam	_	Steam + air	Steam -	+ O2	
	T (T)		_ Other (de						
	_ Type of Test: Geology of Treatment Zone		t test	Full-	-		abla unaanaalid	atad aadimanta	
<u>x</u>	Geology of Treatment Zon	₽.				neous and perme		lidated sediments	
			<u></u>		J	•		ses of lower perme	ahility material
			Δ					yers of higher per	•
					-	ctured bedrock (i.			modeliny material
						x, limestone, sand	-	,	
	_Treatment Targe Zone:		Saturate					aturated and Vados	e zones)
<u>x</u>	Start of Thermal Test:	Jun-		,		-			
	_ Hydraulic Control		_ Yes	No					
<u>x</u>	Treatment Cell Design:								
	Size of target zone (ft2):						t	Jnknown (_ x ft)
	Thickness of target zone (f	t):					t	Inknown	
	Depth to top of target zone	(ft bo	gs):				t	Inknown	
	Thickness of target zone b	elow	water table	e (ft):	<u>5</u>		t	Inknown	
	Number of energy delivery	point	s:		<u>16</u>		U	Jnknown	
	Number of extraction point	s:			<u>6</u>		U	Inknown	
<u>x</u>	Temperature Profile:								
	Initial formation temperatur	e (de	g C):			<u>10</u>		Unknow	n
	Maximum representative for	ormati	ion temper	ature (deg C	;):	<u>60</u>		Unknow	n
	Time to reach maximum re	prese	entative ten	nperature (d	ays):			Unknow	n
	Duration of treatment at re	prese	ntative tem	nperature (da	ays):			Unknow	n
						<u>D</u> ;	<u>ate</u>	Temperatu	ure (deg C)
	Formation temperature imr	nedia	tely post-tr	reatment:					
	Formation temperature pos	st-trea	atment mor	nitoring even	it 1:				
	Duration of post-treatment	moni	toring (day	s):					
	_ Mass of contaminant remo	ved:							
	Via	liquid	pumping:				lb	kg	Unknown
	In va	apor s	stream:				lb	kg	Unknown
	Tota	al:					lb	kg	Unknown
	Comments:								
	Attachments:								
									-

						Facility ID#	#:	<u>0505</u>
Performance								
Remediation Goal:								
	In Groundwater: -							
	_							
	In Soil:							
Was the Remediation								
	Comment: -							
	_							
	In Soil							
	Comment: -							
	_							
General comments on	the thermal applica	ation:						
Lessons Learned								
Lessons Learned								
Energy								
Total Energy Used:			kWhr				_ kWh	
Total Energy Used:	l energy applied to t	reatment zone:	kWhr			_kWhr/m³	_ kWh	kWhr/y
Total Energy Used:		reatment zone:	kWhr				_ kWh	
Total Energy Used: Total	r energy:	reatment zone:	kWhr			_kWhr/m³	_ kWh	kWhr/y
Total Energy Used: Total Othe	r energy:	_	kWhr			_kWhr/m³	_ kWh	kWhr/y
Total Energy Used: Total Othe Cost	r energy:	_	kWhr			_kWhr/m³	_ kWh	kWhr/y
Total Energy Used: Total Othe	r energy:	_	kWhr			_kWhr/m³	_ kWh	kWhr/y
Total Energy Used:TotalOthe Cost Total Project Cost:	r energy:	_	kWhr			_kWhr/m³	_ kWh	kWhr/y
Total Energy Used: Total Othe Cost Total Project Cost: Cons	r energy: Please	_	kWhr	_	_	_ kWhr/m ³ _ kWhr/m ³	_ kWh	kWhr/y
Total Energy Used: Total Othe Cost Total Project Cost: Cons There	er energy: Please	_	kWhr		_	_kWhr/m³	_ kWh	kWhr/y
Total Energy Used: Total Othe Cost Total Project Cost: Cons Then Energy	r energy: Please sultant Cost: mal Vendor Cost:	_	kWhr	_	_	_ kWhr/m ³ _ kWhr/m ³	_ kWh	kWhr/y
Total Energy Used: Total Othe Cost Total Project Cost: Cons Theri Energ Othe	r energy: Please sultant Cost: mal Vendor Cost: gy Cost:	_	kWhr	_	_	_ kWhr/m ³ _ kWhr/m ³	kWh	kWhr/y
Total Energy Used: Total Othe Cost Total Project Cost: Cons Then Energy Othe Othe	er energy: Please sultant Cost: mal Vendor Cost: gy Cost: rr Cost 1:	_	kWhr	_	_	_ kWhr/m ³ _ kWhr/m ³	_ kWh	kWhr/y
Total Energy Used: Total Othe Cost Total Project Cost: Cons Then Energy Othe Othe	r energy: Please sultant Cost: mal Vendor Cost: gy Cost: r Cost 1: r Cost 2: r Cost 3:	_	kWhr	_	_	_ kWhr/m ³ _ kWhr/m ³	_ kWh	kWhr/y

____ Other Cost 3:

General Site Information Facility ID#: 0510 File Analyzed By: <u>x</u> PD ____ Date: 10/26/2006 Type of treatment: ___ Conductive Steam ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: Mar-00 End of Test: Jun-01 Duration: 15 months Type of Site: Non-DOD __ DoD Facility Name: Manufacturing Facility - Plastics City, State, Zip Code: Holyoke, MA OU# or Site #: Primary point of contact: Organization: **ENSR** Address: 2 Technology Park Drive City, State, Zip Code: Westford, MA 01886 Phone #: 978-589-3000 email: ___ Other contacts or vendors who worked on site ____ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

(General Site Ass	sessment Data					Facility ID	D#: <u>0510</u>
-	Impacted 2	Impacted zone a	as defined by documentation od for determining size of im	Width (ft): npacted zone (See source zo		ness (ft):		Unknown
_	Monitor W	/ells: Number of relevant m	nonitoring wells with groundy	water data:				None
		Number of wells relat Pre-treatment Post-treatment	ive to treatment zone: In:	Pre-treatment: Upgradient: Upgradient:	Downgradient:		ssgradient:ssgradient:	
	Soil Boring Types of C		oil borings with pre-treatment oil borings with post-treatment ent zone:	nt data:	treatment zone:			
	<u>.</u> .,,pod o. d	onamina no			Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:
_		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	x Benzene		None	None	None	None
		trans-1,2-dichloroethene	x Tolune	,	None	None	None	None
			x Ethylbenzene		None	None	None	None
			x m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	x o-xylene		None	None	None	None
	Chemicals of Concern	1,1,2-trichloroethane	x styrene		None	None	None	None
	Concern	1,1,2,2-tetrachloroethane	<u> </u>		None	None	None	None
		Vinyl Chloride			None	None	None	None
		viiiyi ciiionde			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
_					None	None	None	None
	Comme	nts:						
								-
	Attachmen	ts:						
		-						

Hydrogeologic Conceptual Model Facility ID#: 0510 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _____ft amsl _ Unknown _ Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: _ Flow direction Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: __ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory _ Field data low ____ Unknown high

Comments:

hermal Treatment - Design				Facility ID#: 0510
Thermal treatment:	Conductive			
	Electrical Resistance	e		
	3 phase	6 phase	AC powe	DC power
	<u>x</u> Steam Steam	Steam + air	Steam + 0	D2
T (T)	Other (describe)			
Type of Test:	_	Full-scale System		
Geology of Treatment Zo		vely homogeneous and per		
		vely homogeneous and imp		
	 . • .	•		s of lower permeability material
			-	ers of higher permeability materi
		etent, but fractured bedroc)
	· 	ered bedrock, limestone, s		
Treatment Targe Zone:	Saturated only	Vadose only		urated and Vadose zones)
Start of Thermal Test:	<u>Mar-00</u>		tion: 15 months	
Hydraulic Control	Yes N	10		
T				
Treatment Cell Design:				
Size of target zone (ft2):				known (x f
Thickness of target zone		<u>25</u>		known
Depth to top of target zo		-		known
Thickness of target zone				known
Number of energy delive				known
Number of extraction poi	ints:		Un	known
Temperature Profile:				
Initial formation tempera	ture (deg C):			Unknown
•	e formation temperature (deg	g C):		Unknown
-	representative temperature			Unknown
	representative temperature			Unknown
Burdion of troumon at	roprocontativo temperaturo	<u></u>		Chknown
			<u>Date</u>	Temperature (deg C)
Formation temperature in	mmediately post-treatment:			
Formation temperature p	post-treatment monitoring ev	vent 1:		
Duration of post-treatme	nt monitoring (days):			
Mass of contaminant ren				
	ia liquid pumping:		lb	kg Unkno
	vapor stream:		lb	kgUnkno
To	otal:		lb	kgUnkno
Comments:				
22,500	yd3 treated in two ares o	of 1600 yd2 and 1100 yd	<u>2</u>	
Attachments:				

Cos	st and Perfor	rmance				Facility ID#:	<u>0510</u>
	_ Performar	nce					
	Remediati						
		In Groundwa	ater: —				
		_					
		In Soil:					
		- -					
	Was the D	Remediation Goal Achiev	a d.				
	was the R						
		In Groundw					
		Comm	—				
		In Soil					
		Comm					
		Collin					
			_				
	General co	omments on the thermal	applicat	ion:			
	Lessons L	earned					
							
	_ Energy						
	Total Ener	rgy Used:			kWhr kWhr/r		
		Total energy appl	ied to tre	eatment zone:		kWhr/m ³	kWhr/yd ³
		Other energy:				kWhr/m ³	kWhr/yd ³
			Please n	ote other energy:			
v	Cost						
<u>x</u>	Total Proje	act Cast:		\$46/yd3			
	Total Troje	Consultant Cost:		<u>\$40/\$45</u>			
			Coot:				
		Thermal Vendor (2051.		m ³ m	yd³	
		Energy Cost:		950000		yu	
		X Other Cost 1:		850000			
		x Other Cost 2:		<u>180000/yr</u>			
	v 5	Other Cost 3:		Other Coot 4:		tal agat	
	<u>x</u> Plea	se note other cost:	X	Other Cost 1:		tal cost	
			<u>X</u>	Other Cost 2:	<u>C</u>	<u>M&M</u>	
				Other Cost 3:			

General Site Information Facility ID#: 0515

<u>x</u>	File Analyzed By: JT	<u>x</u> PD <u>x</u>					Date:	9/13/2006
	Type of treatment:	x Conductive	Steam		ERH	Other:		
	Type of Contaminant:	Chlorinated Solv	rents <u>x</u>	Pet	roleum Hydrod	earbons	Pesticides	
		Wood Treating	<u>></u>	Oth	er: <u>coal ta</u>	ar, PCP, B(a)P		
	Treatment Status:	Active	$\underline{\mathbf{x}}$ Post					
	Type of Test:	Pilot Test	x Full Sc	ale Syste	em			
	Start of Test:	<u>4-Mar</u>	E	nd of Tes	st: <u>5-Mar</u>		Duration: 360	
	Type of Site:	<u>x</u> Non-DOD	DoD					
<u>x</u>	Facility Name: Former Ma	anufactured gas plant						
	City, State, Zip Code: OU# or Site #:	North Adams, MA						_
<u>x</u>	Primary point of contact: Organization: TerraTherr Address: 356 Broad Street							
	City, State, Zip Code: Phone #: 978-343-0300	Fitchburg. MA	email: <u>r</u>	baker@t	erratherm.com			
	Other contacts or vendors where Point of contact:	ho worked on site			None			
	Type:Vendor, Co	onsultant	_ Vendor, Tech		_	Oth	er	_
	Address:							
	City, State, Zip Code:							
	Phone #:		email: _					
Q.	A/QC							
	_ Characteristics of Interest							
	Good pre- and post-tre	atment groundwater data	ı	<u>x</u>	Good pre- a	nd post-treatmer	nt soil data	
	Good temperature prof	file vs. time information			Flux assessi	nent		
	Groundwater elevation	ns			Geologic cr	oss-section		
	Hydraulic Conductivity	y information						

2	x Impacted 2	x Impacted zone a	as defined by documentation od for determining size of in	Width (ft): npacted zone (See source zo		oness (ft): 18		Unknown
2	<u>x</u> Monitor W	/ells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:	1	Post-treatment: _		None
		Number of wells relat	tive to treatment zone:					
		Pre-treatment	ln: 1	Upgradient:	Downgradient:	Cr	ossgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cr	ossgradient:	
					· ·		· —	
2	x Soil Boring	s: Number of relevant so	oil borings with pre-treatmen	t data: 8				
		Number of relevant so	oil borings with post-treatmen	nt data: 7				
		Number inside treatme	ent zone: 6 pre, 7 post	Number outside	treatment zone:	<u>2</u>		
,	x Types of C	ontaminants						
						ent Concentration per nical:		nent Concentration per mical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
ľ		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel	x TPH*	None	5,000 mg/kg	None	50 mg/kg
		1,1-dichloroethene	x Napthalene		None	500 mg/kg	None	5 mg/kg
		cis-1,2-dichloroethene	x Benzene		None	1,000 mg/kg	None	0.5 mg/kg
		trans-1,2-dichloroethene	x Tolune		None	None	None	None
		1,1-dichloroethane	<u>x</u> Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene	x coal tar	None	None	None	None
		1,1,1-trichloroethane	o-xylene	x benzo(a)pyrene	None	10 mg/kg	None	0.5 mg/kg
	Chemicals of Concern	1,1,2-trichloroethane	x xylenes (total)		None	None	None	None
	Concern	1,1,2,2-tetrachloroethane		x pentachlorophenol	None	None	None	None
		Vinyl Chloride		x phenanthrene	None	100 mg/kg	None	5 mg/kg
				x methy napthalene	None	None	None	None
				x anthracene	None	10 mg/kg	None	0.5 mg/kg
				x benzo(a)anthracene	None	10 mg/kg	None	0.5 mg/kg
				x chrysene	None	10 mg/kg	None	0.5 mg/kg
				x pyrene	None	50 mg/kg	None	1 mg/kg
				x fluoranthene	None	50 mg/kg	None	1 mg/kg
					1			3 3
	Commer	nts: <u>unadjusted</u>		<u>* C11 - (</u>	C22 aromatics			
		Nur	mbers are based on the d	epths of 6 to 14 feet, see the	ne attached sheet for	concentrations per	chemical average for	14 to 18 feet
	Attachmen	ts:						

0515

General Site Assessment Data

Hydrogeologic Conceptual Model Facility ID#: 0515

<u>x</u>	Geology:	Zor	<u>ne</u>	Unc	onsolidate	ed Sedir	nents							
		Vadose 2	Zone:	<u>x</u>	Relativel	y homo	geneo	us and p	ermeable	e unconsolid	ated sedi	iments		
					Relativel	y homo	geneo	us and in	npermea	ble unconso	lidated se	ediments		
					Largely	permeal	ole se	diments v	vith inter-	bedded lens	es of low	er permeabi	lity material	
	Largely impermeable sediments with inter-bedded layers of									yers of h	igher perme	ability material		
					Compete	ent, but	fractu	ed bedro	ck (i.e. c	rystalline roo	ck)			
					Weather	ed bedr	ock, li	mestone,	sandsto	ne				
		Saturate	d Zone:		Relativel	y homo	geneo	us and p	ermeable	unconsolid	ated sedi	iments		
					Relativel	y homo	geneo	us and in	npermea	ble unconso	lidated se	ediments		
					Largely	permeal	ole se	diments v	vith inter-	bedded lens	es of low	er permeabi	lity material	
					Largely i	mperme	eables	sediment	s with int	er-bedded la	yers of h	igher perme	ability material	
					Compete	ent, but	fractu	ed bedro	ck (i.e. c	rystalline roo	ck)			
					Weather	ed bedr	ock, li	mestone,	sandsto	ne				
<u>x</u>	Ground surface	e elevation based	on wells in	or adja	cent to tre	eatment	zone:	_		ft amsl		<u>x</u>	Unknown	
<u>x</u>	Aquifer Charac	teristics:												
	Is more than 1	aquifer present?	<u>x</u>	No	_	Yes	s (num	ber):			Unk	cnown (assum	e single aquifer)	
				,	Aquifer 1			Aquifer	2	Aquif	er 3			
	Depth to water:	low value	e (ft bgs):	<u>3</u>										
	high value (ft bgs):													
		Unknowr	n:											
	_ Flow direction													
<u>x</u>	Horizontal hydr	aulic gradient (fe	et/foot):									<u>x</u>	Unknown	
	Vertical hydrau	lic gradient (feet/	foot):									<u>x</u>	Unknown	
<u>x</u>	K range (ft/day))	Measured	using	:	Slug	Test	_	Labor	atory		Field data		
			low									<u>x</u>	Unknown	
			high				-							
	Transmissivity	(ft2/day):	Measured	using	: _	Slug	Test	_	Labor	ratory		_ Field data		
			low									<u>x</u>	Unknown	
			high											
	Comments:		i											
		Geology is all fill:	<u>L</u>											
			Local aqu	ifer ou	ıtside of t	the gas	holde	er is DTV	N = 33 ft	t				_
	Attachments:													_
														-
														-

The	rmal Treatment - Des	ign							Facility	/ ID#:	<u>0515</u>	
<u>x</u>	Thermal treatment:	x	Conductive	e								
			_Electrical I	Resistance								
			Steam	_ 3 phase		6 phase		AC po	wer _	DC	power	
			_ Steam	Steam		Steam + air	r	Steam	+ O2			_
			Other (des	cribe)								
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Ful	ll-scale S	System						
<u>x</u>	Geology of Treatme	ent Zone:	<u>x</u>	Relativel	ly homo	geneous and per	rmeabl	e unconsolio	lated sedim	ents		
				_ Relativel	ly homo	geneous and imp	permea	able unconso	olidated sed	iments		
				_ Largely p	permea	ble sediments wit	th inter	-bedded len	ses of lowe	r perme	ability materi	al
				_ Largely i	mperm	eable sediments	with in	ter-bedded la	ayers of hig	her perr	meability mat	terial
				_ Compete	ent, but	fractured bedroc	k (i.e. c	crystalline ro	ck)			
				_ Weather	ed bedi	ock, limestone, s	sandsto	one				
<u>x</u>	Treatment Targe Zo	one:	_ Saturated	only	<u>x</u>	Vadose only		Both (S	Saturated and	i Vadose	zones)	
<u>X</u>	Start of Thermal Te	st: <u>4-Ma</u>	<u>ır</u>			Dura	ation:	370 days				
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No								
<u>x</u>	Treatment Cell Des	ign:										
	Size of target zone	(ft2):			3020				Jnknown	(!	<u>62</u> x <u>6</u> 2	<u>2</u> ft)
	Thickness of target	zone (ft):			<u>12</u>				Jnknown			
	Depth to top of target zone (ft bgs):				<u>5</u>				Jnknown			
	Thickness of target zone below water table (ft):				<u>12</u>				Jnknown			
	Number of energy of	delivery points	S :		<u>25</u>				Jnknown			
	Number of extraction	n points:			<u>8</u>				Jnknown			
<u>x</u>	Temperature Profile) :										
	Initial formation tem	perature (deg	g C):			<u>16</u>				Jnknowr	n	
	Maximum represen	tative formation	on tempera	ture (deg	C):	<u>325</u>				Jnknowr	n	
	Time to reach maxi	mum represe	ntative tem	perature (days):	<u>291</u>				Jnknowr	n	
	Duration of treatme	nt at represer	ntative temp	perature (c	days):	<u>79</u>			t	Jnknowr	n	
							<u>Date</u>		<u>Ter</u>	nperatu	ıre (deg C)	
	Formation temperat	ure immediat	ely post-tre	eatment:		3/17/2005			<u>271</u>			
	Formation temperature post-treatment monitoring ever				nt 1:	6/3/2005			<u>123</u>			
	Duration of post-tre	atment monito	oring (days):		<u>90</u>						
<u>x</u>	Mass of contaminal	nt removed:										
		Via liquid _l	pumping:		16,700	gal of coal tar		lb	k	:g	Un	known
		In vapor s	tream:		166,000	as napthalene		<u>x</u> lb	k	:g	Un	known
		Total:						lb	k	īg	Un	known
	Comments:											
	25	wells snace	ed on ~12f	t centers	Oners	ated in 3 stages	· 1) de	watering 2) thermally	/-enhar	ced free-pro	oduct
						D to achieve tar						Judot
	Attachments:											_
	_											

Cost and Performance Facility ID#: 0515

<u>x</u>

<u>x</u>

Performance
Remediation Goal:
X In Groundwater: (1) eliminate DNAPL, (2) reduce VOCs and SVOCs, VPH, EPH to below UCLs via ISTD; (3) reduce VOSc, SVOCs, VPH, EPH, to below S-3 GW - 1 standards
<u>x</u> In Soil: <u>Benzo(a)pyrene [B(a)P] - 4 mg/kg; Benzene - 10 mgkg; TPH* - 200 mg/Kg (* C11-C22 aromatics, unadjusted)</u>
Was the Remediation Goal Achieved:
In Groundwater
Comment: —
<u>x</u> In Soil
Comment:
was met from 6-14 feet, but not from 14-18' except for benzen which was met.
General comments on the thermal application:
Lessons Learned
_
Energy
Total Energy Used: <u>701,000</u> <u>x</u> kWhr kWhr/m ³ kWhr/yd ³
Total energy applied to treatment zone:kWhr/yd
Other energy: kWhr/yd
Please note other energy:
Cost
Total Project Cost:
Consultant Cost:
x Thermal Vendor Cost: 850,000
<u>x</u> Energy Cost: <u>55,000</u> m ³ yd ³
Other Cost 1:
Other Cost 1:
Other Cost 3:
-
Other Cost 2: Other Cost 3:

General Site Information Facility ID#: 0517 File Analyzed By: Date: 8/20/2007 PD ____ Type of treatment: Conductive Steam ERH ____ Pesticides Type of Contaminant: Chlorinated Solvents <u>X</u> Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: End of Test: 3/16/2007 8/15/2006 Duration: 214 Days Type of Site: Non-DOD _ DoD Facility Name: South Eastern MA Address: City, State, Zip Code: South Eastern MA OU# or Site #: Primary point of contact: Ralph Baker Organization: TerraTherm Address: 10 Stevens Road City, State, Zip Code: Fitchburg, MA 01420 Phone #: 978-343-0300 email: rbaker@terratherm.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: Vendor, Consultant ____ Other Organization: Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data

__ Flux assessment

_ Geologic cross-section

____ Good temperature profile vs. time information

___ Hydraulic Conductivity information

____ Groundwater elevations

General Site As	sessment Data					Facility II	D#: <u>0517</u>			
Impacted	X Impacted zone a	as defined by documentation and for determining size of im			ness (ft): <u>21</u>		Unknown			
Monitor V		nonitoring wells with ground	water data: Pre-treatment:	<u>22</u>	Post-treatment:	<u>20</u>	None			
		tive to treatment zone:								
	Pre-treatment	ln: <u>1</u>	Upgradient: 0	Downgradient:	_	ssgradient: 8				
	Post-treatment	In: <u>0</u>	Upgradient: <u>0</u>	Downgradient:	<u>13</u> Cros	ssgradient: 8				
Soil Borings: Number of relevant soil borings with pre-treatment data: 1 Number of relevant soil borings with post-treatment data: 20 Number inside treatment zone: 20 Number outside treatment zone:										
Types of C	Jonannana									
					ent Concentration per nical:		ent Concentration per nical:			
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
	Trichloroethene	Hexane	Creosote	None	None	None	None (mg ng)			
	Tetrachloroethene	Jet Fuel		None	None	None	None			
	1,1-dichloroethene	X Napthalene		None	5,000 mg/kg	None	50 mg/kg			
	cis-1,2-dichloroethene	Benzene		None	None	None	None			
	trans-1,2-dichloroethene	X Tolune		None	500 mg/kg	None	0.5 mg/kg			
	1,1-dichloroethane	X Ethylbenzene		None	1 mg/kg	None	0.01 mg/kg			
	1,2-dichloroethane	X m/p-xylene		None	1 mg/kg	None	0.01 mg/kg			
	1,1,1-trichloroethane	X o-xylene		None	1 mg/kg	None	0.01 mg/kg			
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None			
001100111	X 1,1,2,2-tetrachloroethane			None	0.1 mg/kg	None	0.01 mg/kg			
	Vinyl Chloride			None	None	None	None			
	X Trichlorobenzene 1,2 and 1,3 and 1,4			None	5,000 mg/kg	None	10 mg/kg			
	X dichlorobenzene			None	500 mg/kg	None	0.5 mg/kg			
	X trimethylbenzene			None	1 mg/kg	None	0.01 mg/kg			
	X chlorobenzene			None	100 mg/kg	None	0.01 mg/kg			
				None	None	None	None			
				None	None	None	None			
				•						
Comme	Comments:									
	-									
Attachmen	nts:									

Hydrogeologic Concep	otual Model							Facility ID#:	0517
Geology:	Zone Vadose Zone Saturated Zo	:: <u>}</u> - - - -	Relative Largely Largely Compe Weathe Relative Relative Largely Largely Compe	ely homogely homogely permeable impermedetent, but for ely homogely homogely homogely permeable impermedetent, but for ely homogely h	geneous ar geneous ar ole sediment ractured b ock, limest geneous ar geneous ar ole sediment ractured b	nd impermea nts with inter- nents with int edrock (i.e. c one, sandsto nd permeable nd impermea nts with inter- nents with inter-	e unconsolidated s ble unconsolidated bedded lenses of er-bedded layers of erystalline rock)	I sediments ower permeability of higher permeab ediments I sediments lower permeability	ility material
	elevation based on v	wells in or a				<u>200</u>	ft amsl	τ	Jnknown
Aquifer Characte			_						
Is more than 1 a	quiter present?	<u>X</u> N	No Aquifer 1		(number):	uifer 2	X (Aquifer 3	Jnknown (assume s	single aquifer)
Depth to water:	low value (ft l high value (ft Unknown:		4 .6				Aquilei 3	 	
Flow direction		<u>N</u>	North					_	
	ulic gradient (feet/foct)		<u>0.01</u>						Jnknown Jnknown
K range (ft/day)	M	leasured us	sing: <u>X</u>	Slug	Test	Labor	ratory _	Field data	
Transmissivity (f	hi t2/day): M lo	igh _ leasured us	2.8 sing:	Slug	Test	Labor	atory	Field data	Jnknown Jnknown
	0-14 ft bgs con	sisted of f	ill material a	and laye	rs of tar (r	napthalene,	toluene, TCB, DC	CB and MCB). 1	4-21 ft bgs
Comments:	consisted of nativ					,		,	
Attachments:									

The	rmal Treatment - D	esign						I	Facility ID#:	<u>0517</u>
<u>X</u>	Thermal treatmer	nt: <u>X</u>	Conductiv	ve <u>In Si</u>	tu Thermal D	Desorption				
			_ Electrical	Resistance						
			Steam	_ 3 phase		6 phase		_ AC power	DO	C power
			_	Steam		Steam + air		_ Steam + O2		
			_ Other (des							
	Type of Test:		t test	_	scale System					
	_Geology of Treati	ment Zone:	X	-	_	ous and perme				
				-	_	ous and impern				1.00
			_			diments with in			-	·
			_						of higher peri	meability material
			_	_		red bedrock (i.	-	talline rock)		
	Transfer and Torre	7	Caturata	 '		imestone, sand		Dad (Caran		
	_Treatment Targe		_ Saturated	a only	Vado	-	<u>X</u>		ted and Vadose	zones)
	_ Start of Thermal T		<u>/2007</u>	No		Duration	1: <u>214</u>	Days		
	_ Hydraulic Control	<u>X</u>	Yes	No						
	_Treatment Cell D	esian:								
	Size of target zon	-			10,175			Unkno	wn (_ x ft)
	Thickness of targ				21			Unkno		,
	Depth to top of target zone (ft bgs): Thickness of target zone below water table (ft): Number of energy delivery points:				0			Unkno		
				(ft):	5 to 7			Unkno		
					70	TT 1.	r	Unkno		
	Number of extrac	tion points:			70 Lateral Screens were Used for Vapor Extraction Unknown Unknown					
	_Temperature Pro	file:								
	Initial formation to	emperature (de	g C):			<u>15</u>			Unknow	n
	Maximum represe	entative formati	on tempera	ature (deg C):	150 (vadose), 1	00 (satı	urated)	Unknow	n
	Time to reach ma	ximum represe	ntative ten	nperature (da	ays):	200 Days		•	Unknow	n
	Duration of treatn	nent at represe	ntative tem	perature (da	ys):				Unknown	n
						Da	ate_		Temperatu	re (deg C)
	Formation tempe	rature immedia	tely post-tr	eatment:						
	Formation tempe	rature post-trea	itment mon	nitoring event	11:					
	Duration of post-t	reatment moni	oring (days	s):						
	_ Mass of contamir									
		•	pumping:		<u>?</u>				kg	Unknown
		In vapor s	tream:		15,00		<u>X</u>		kg	Unknown
		Total:			>>1500	<u>00</u>	<u>X</u>	lb .	kg	Unknown
	-	Mass remove	d by the h	ydraulic cor	ntainment/N	NAPL recover	y syste	em unknown	at this_	
	:									
	Attachments:									
	•									-

Cost and Performance Facility ID#: 0517 Performance Remediation Goal: In Groundwater: -In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: X In Soil Comment: saturated zone. No evidence of vertical mobilization of tar/NAPL based on visual inspection of soil cores through treated tar zones and post treatment soil concentration General comments on the thermal application: Lessons Learned Energy _ kWhr/yd³ ____ kWhr/m³ Total Energy Used: 1,900,000 kWhr _ Total energy applied to treatment zone: _ kWhr/yd³ kWhr/m³ __ Other energy: kWhr/m³ _ kWhr/yd³ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ___ Thermal Vendor Cost: 1,370,000 ___ Energy Cost: 266,000 ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1: Other Cost 2:

Other Cost 3:

General Site Information Facility ID#: 0520 <u>X</u> PD ____ File Analyzed By: Date: 11/9/2006 ____Steam Type of treatment: _Conductive X ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: \underline{X} Post ___ Active Type of Test: X Pilot Test Full Scale System Start of Test: 10/11/2002 End of Test: 1/9/2003 Duration: 90 d Type of Site: DoD ___Non-DOD <u>X</u> Facility Name: Silresim Superfund Site Address: City, State, Zip Code: Lowell, MA OU# or Site #: _ Primary point of contact: Jim DiLorenzo Organization: Address: City, State, Zip Code: Phone #: 617-918-1247 email: dilorenzo.jim@epa.gov Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

X Impacted Zone: Length (parallel to flow direction)(ft.): 725 Width (ft): 225 Thickness (ft): Unknown 40 ____ Impacted zone as defined by documentation ____ Alternative method for determining size of impacted zone (See source zone definition attachments) ____ Map attachment Monitor Wells: Number of relevant monitoring wells with groundwater data: None Pre-treatment: 7 Post-treatment: Number of wells relative to treatment zone: Upgradient: 2 Pre-treatment In: <u>3</u> Downgradient: 2 Crossgradient: _ Upgradient: 2 Downgradient: 2 Post-treatment In: 3 Crossgradient: X Soil Borings: Number of relevant soil borings with pre-treatment data: 10 Number of relevant soil borings with post-treatment data: 8 Number inside treatment zone: 3 Number outside treatment zone: 5 X Types of Contaminants Average Pre-treatment Concentration per Average Post-treatment Concentration per Chemical: Chemical: Other Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L) Soil (mg/kg) Chlorinated Solvents Petroleum Hydrocarbons Trichloroethene Hexane Creosote 500 mg/L 500 mg/kg 50 mg/L 5 mg/kg ___ Jet Fuel Tetrachloroethene 10 mg/L 100 mg/kg 5 mg/L 0.5 mg/kg __1,1-dichloroethene ___ Napthalene None None None None __ cis-1,2-dichloroethene None __ Benzene None None None _ trans-1,2-dichloroethene X Tolune 10 mg/L None 1 mg/L None __1,1-dichloroethane X Ethylbenzene 5 mg/L 100 mg/kg 1 mg/L 0.5 mg/kg __1,2-dichloroethane None None ___ m/p-xylene None None X 1,1,1-trichloroethane _ o-xylene 100 mg/L None 10 mg/L None Chemicals of __1,1,2-trichloroethane X Xylenes 5 mg/L 500 mg/kg 1 mg/L 0.1 mg/kg Concern ___1,1,2,2-tetrachloroethane 10 mg/L None 1 mg/L None Styrene _ Vinyl Chloride Acetone 10 mg/L 10 mg/kg 100 mg/L 5 mg/kg X Chloroform 50 mg/L None 5 mg/L None X Chlorobenzene 10 mg/L None 1 mg/L None Total VOCs X 500 mg/L None 100 mg/L None Total chlorinated VOCs 500 mg/L None 50 mg/L None Total aromatics 50 mg/L None 10 mg/L None VOCs - Ketones 10 mg/L None 100 mg/L None Comments: Attachments:

Facility ID#:

0520

General Site Assessment Data

Unknown

low

high

Comments:

Attachments:

The	rmal Treatment - Design							ı	Facility ID#:	<u>0520</u>
<u>X</u>	Thermal treatment:		_ Condi	active _						
		<u>X</u>	Electr	ical Resistanc	e					
			_ Steam		e <u>X</u>	6 phase		_AC power	DC	power
			_ Steam	Steam	_	Steam + ai	ir	Steam + O2		
			Other	(describe)						
<u>X</u>	Type of Test: X	Pilot	test	F	Full-scale Sys	tem				
<u>X</u>	Geology of Treatment Zone	э:		Relativ	vely homoge	neous and pe	rmeable un	consolidated	sediments	
				Relativ	vely homoge	neous and im	permeable	unconsolidate	ed sediments	
				X Largel	y permeable	sediments w	ith inter-bed	ded lenses o	f lower perme	ability material
				Largel	y impermeal	ole sediments	with inter-b	edded layers	of higher perr	neability material
				Comp	etent, but fra	ctured bedroo	ck (i.e. cryst	alline rock)		
						k, limestone,				
<u>X</u>	Treatment Targe Zone:		Satur		v		<u>X</u>	Both (Satura	ted and Vadose	zones)
<u>X</u>	Start of Thermal Test:		1/2002	,		•	ation: 90 d			,
<u>X</u>	Hydraulic Control	X	Yes	1	No					
	riyaraano comici	~	100							
<u>X</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>850</u>			Unkno	wn (_ x ft)
	Thickness of target zone (fi	۴۱۰			<u>40</u>			Unkno		_
	- '		ic).		2.5			Unkno		
	Depth to top of target zone			able (ft):						
	Thickness of target zone be			able (II).	<u>35</u>			Unkno		
	Number of energy delivery		5.		<u>12</u>			Unkno		
	Number of extraction points	S:			<u>4</u>			Unkno	wn	
<u>x</u>	Temperature Profile:									
	Initial formation temperatur	e (de	a C).			<u>10</u>			Unknowr	
	Maximum representative for		-	nerature (de	u C).	105		•	Unknown	
	Time to reach maximum re					~73		•	Unknowr	
		-		•				•	Unknowr	
	Duration of treatment at rep	Jiesei	itative	temperature	(uays).	<u>~17</u>		•	UIKIIOWI	ı
							<u>Date</u>		Temperatu	re (deg C)
	Formation temperature imp	nedia	tely pos	st-treatment:						
	Formation temperature pos	st-trea	tment i	monitoring e	vent 1:					
	Duration of post-treatment	monit	oring (days):						
<u>X</u>	Mass of contaminant remove	ved:								
	Via I	iquid	pumpir	ng:				_ lb	kg	Unknown
	In va	apor s	tream:					_ lb	kg	Unknown
	Tota	ıl:			1	500	<u>X</u>	lb .	kg	Unknown
	Comments:									
	Commonts.									
	Attachments:									

<u>X</u>	Performance Remediation Goal:					
		In Groundwater: -				
		<u> </u>				
		In Soil:				
	Was the Remediation	on Goal Achieved:				
		In Groundwater _				
		Comment: -				
		In Soil				
	_	Comment:				
		-				
		_				
	General comments	on the thermal applic	ation:			
	Objective: Pro	ove efficacy of ERH a	at site by reducing soil a	nd groundwater contam	inant concentrations.	
	Lessons Learned					
	Tubing in 70 w	vells melted, so need	to use a non-coated te	flon tubing with a thick w	<u>/all</u> .	
~	Energy					
<u>X</u>	Total Energy Used:	286,20	ın	Y kWhr	kWhr/m³ I	k\Whr/vd ³
	5,	tal energy applied to		<u> </u>	kWhr/m ³	kWhr/yd ³
		her energy:			kWhr/m ³	kWhr/yd³
	<u></u> 5		note other energy:			
		<u>——</u> : ::::::				
<u>X</u>	Cost					
	Total Project Cost:		<u>1,600,000</u>			
	Co	nsultant Cost:				
	Th	ermal Vendor Cost:	400,000			
	En	ergy Cost:	30,000	m ³	yd ³	
	<u>X</u> Otl	her Cost 1:	<u>180,000</u>			
	<u>X</u> Otl	her Cost 2:	<u>140,000</u>			
	<u>X</u> Otl	her Cost 3:	800,000			
	X Please note of	ther cost:	_	drilling, site prep an	nd restoration and pre- and	d post- sampling
		Σ	Other Cost 2:	<u>lab (</u>	80,000) and GAC (60,000	Ù
		<u>></u>	Other Cost 3:		everything else	

0520

Cost and Performance

General Site Information Facility ID#: 0528 PD ____ File Analyzed By: Date: 10/18/2006 ____Steam ____Other: Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating _Other: Treatment Status: ___ Active Post ____ Full Scale System Type of Test: ___ Pilot Test Start of Test: End of Test: _____ Duration: _____ Type of Site: ___DoD Non-DOD Facility Name: Naval Station Annapolis Address: City, State, Zip Code: Annapolis, MD OU# or Site #: Primary point of contact: Steven Kawachak Organization: Address: City, State, Zip Code: Phone #: 609-588-6349 email: sgkawachak@shawgrp.com Other contacts or vendors who worked on site __ None Point of contact: Type: Vendor, Consultant Vendor, Technical Applications ____Other Organization: Address: City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment

____ Geologic cross-section

____ Groundwater elevations

_____ Hydraulic Conductivity information

General Site As	sessment Data					Facility I	ID#: <u>0528</u>
Impacted	Zone: Length (parallel to flow	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
	Impacted zone a	as defined by documentation	ı				
	Alternative meth	nod for determining size of im	pacted zone (See source zo	one definition attachmer	nts)		
	Map attachment	t					
Monitor V	Vells: Number of relevant n	nonitoring wells with groundy	water data:				None
			Pre-treatment:		Post-treatment:		
	Number of wells relat	tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				g			
Soil Boring	ne: Number of relevant ed	oil borings with pre-treatment	t data:				
	=	oil borings with post-treatmen	·				
	Number inside treatme	- '					
	Number inside treatme	ent zone:	_ Number outside	e treatment zone:			
	Dt						
x Types of C	Contaminants						
					ent Concentration per		nent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Cher Groundwater (mg/L)	nical: Soil (mg/kg)	Che Groundwater (mg/L)	mical: Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None None	None None	None None	None
	Tetrachloroethene	Jet Fuel	Cressure	None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern				None			
	x 1,1,2,2-tetrachloroethane			0.01 mg/L	100 mg/kg	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
			Estimated 60,00	0 lbs of TCE in the so	il.		
			<u> </u>				
Attachmer	nts:						
	-						

Hydrogeologic Conceptual Model Facility ID#: 0528 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments __ Relatively homogeneous and impermeable unconsolidated sediments __ Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments __ Largely permeable sediments with inter-bedded lenses of lower permeability material _ Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) _ Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): 60 high value (ft bgs): Unknown: _ Flow direction _ Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: ___ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory _ Field data low ____ Unknown high

Comments:

Attachments:

The	rmal Treatment - Design					Fac	ility ID#:	<u>0528</u>
<u>x</u>	Thermal treatment:	Con	ductive					
		x Elec	trical Resistance					
			3 phase	6 phase		_ AC power	DC	power
		Stea	m		-			
			Steam	Steam +	air	_ Steam + O2		
		Othe	r (describe)					
	Type of Test:	Pilot test	Full	-scale System				
	_Geology of Treatment Zone	э:	Relatively	y homogeneous and	permeable ur	consolidated sed	iments	
			Relatively	homogeneous and	impermeable	unconsolidated s	ediments	
			Largely p	ermeable sediments	with inter-bed	dded lenses of lov	ver perme	ability material
			Largely ir	mpermeable sedimer	its with inter-b	edded layers of h	nigher perr	neability material
			Compete	nt, but fractured bedr	ock (i.e. crys	talline rock)		
			Weather	ed bedrock, limestone	e, sandstone			
	_Treatment Targe Zone:	Sati	rated only	Vadose only	<u>x</u>	Both (Saturated a	and Vadose	zones)
	_ Start of Thermal Test:			D	uration:			
	_ Hydraulic Control	Yes	No					
<u>x</u>	Treatment Cell Design:							
	Size of target zone (ft2):			<u>8577</u>		Unknown	(<u>1</u>	16 x 94 ft)
	Thickness of target zone (f	,		<u>56</u>		Unknown		
	Depth to top of target zone (ft bgs): Thickness of target zone below water table (ft):			<u>29</u>		Unknown		
			table (ft):	<u>25</u>		Unknown		
	Number of energy delivery	-		<u>24</u>		Unknown		
	Number of extraction points	S:				Unknown		
	_ Temperature Profile:							
	Initial formation temperatur	e (dea C):					_ Unknown	ı
	Maximum representative for		nperature (deg C	 :):			_ _ Unknown	
	Time to reach maximum re						- Unknown	
	Duration of treatment at rep	•	. ,	• •			Unknown	ı
	·						_	
					<u>Date</u>]	- emperatu	re (deg C)
	Formation temperature imp	nediately p	ost-treatment:					
	Formation temperature pos	st-treatmen	monitoring ever	nt 1:				
	Duration of post-treatment	monitoring	(days):					
	_ Mass of contaminant remo					_		
		iquid pump	-				_ kg	Unknown
		apor stream	: <u> </u>				_ kg	Unknown
	Tota	ıl:				lb	_ kg	Unknown
	Comments:							
	Attachments:							

Cost and Performance Facility ID#: 0528 Performance Remediation Goal: In Groundwater: <u>x</u> In Soil: 90% reduction in soil of 9.7 mg/kg Was the Remediation Goal Achieved: ____ In Groundwater Comment: ___ In Soil Comment: General comments on the thermal application: Lessons Learned

_ Energy				
Total Energy Used:		kWhr		kWhr/yd ³
Total energy applie	ed to treatment zone:		kWhr/r	m ³ kWhr/yd ³
Other energy:			kWhr/r	m ³ kWhr/yd ³
P	lease note other energy:			
_ Cost				
Total Project Cost:				
Consultant Cost:				
Thermal Vendor C	ost:			
Energy Cost:			m^3 yd^3	
Other Cost 1:				
Other Cost 2:				
Other Cost 3:				
Please note other cost:	Other Cost 1:			
	Other Cost 2:			
	Other Cost 3:			

General Site Information Facility ID#: 0530 11/4/2006 File Analyzed By: PD ____ Date: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: End of Test: <u>11/19/2002</u> 9/1/2002 Duration: 83 d Type of Site: DoD Non-DOD <u>X</u> Facility Name: Loring Air Force Base Address: City, State, Zip Code: Limestone, ME OU# or Site #: Primary point of contact: Eva Davis Organization: US EPA - Kerr Laboraties Address: City, State, Zip Code: Ada, OK 74820 Phone #: <u>580-436-8548</u> email: davis.eva@epamail.epa.gov Other contacts or vendors who worked on site _ None Point of contact: Naji Akladiss Type: ___ Vendor, Consultant __ Vendor, Technical Applications __ Other Organization: ME Department of Environmental Protection Address: City, State, Zip Code: Augusta, ME 04333 Phone #: _____ email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

Impacted Zone: Length (parallel to flow direction)(ft.): Impacted zone as defined by documentati			Width (ft): _	Thick	iness (ft):		Unknown			
			od for determining size of im		zone definition attachmer	nts)				
		Map attachment		,		,				
<u>x</u> Monitor \	Nells:	Number of relevant m	nonitoring wells with groundy	vater data:				None		
				Pre-treatment	t: <u>15</u>	Post-treatment:	<u>15</u>			
		Number of wells relat	ive to treatment zone:							
		Pre-treatment	In: <u>15</u>	Upgradient:	Downgradient:	Cro	ssgradient:			
		Post-treatment	In: <u>15</u>	Upgradient:	Downgradient:	Cro	ssgradient:			
x Soil Borings: Number of relevant soil borings with pre-treatment data: 17										
Number of relevant soil borings with post-treatment data: $\underline{8}$										
Number inside treatment zone: 17 Number outside treatment zone: 8										
x Types of 0	Contamina	ants								
					Average Pre-treatme	ent Concentration per		ent Concentration per		
					Cher		Cher			
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)		
		ichloroethene	Hexane	Creosote	0.001 mg/L	1 mg/kg	0.005 mg/L	0.1 mg/kg		
		trachloroethene	Jet Fuel		1 mg/L	10 mg/kg	0.05 mg/L	1 mg/kg		
		I-dichloroethene	Napthalene		None	0.05 mg/kg	0.001 mg/L	None		
		•	Benzene		None	0.1 mg/kg	0.001 mg/L	0.1 mg/kg		
		ns-1,2-dichloroethene	Tolune	-	None	0.05 mg/kg	None	0.01 mg/kg		
		1-dichloroethane 2-dichloroethane	X Ethylbenzene		0.001 mg/L	0.1 mg/kg	0.001 mg/L	None		
			m/p-xylene	-	None	None	None	None		
Chemicals of		1,1-trichloroethane	o-xylene		None	None	None	None		
Concern		1,2-trichloroethane	X Benzene		0.001 mg/L	0.05 mg/kg	0.001 mg/L	0.1 mg/kg		
		1,2,2-tetrachloroethane	x <u>Toluene</u>		None	0.5 mg/kg	0.001 mg/L	0.1 mg/kg		
		nyl Chloride			None	0.05 mg/kg	None	None		
	X car	rbon tetrachloride			0.001 mg/L	None	0.01 mg/L	None		
			x xylene		0.005 mg/L	0.5 mg/kg	0.01 mg/L	0.1 mg/kg		
			x <u>chlorobenzen</u>		None	0.05 mg/kg	0.001 mg/L	0.05 mg/kg		
			X styrene		0.005 mg/L	None	None	None		
	<u>x</u> <u>me</u>	ethylene chloride			0.001 mg/L	None	None	None		
			x <u>napthalene</u>		None	None	0.001 mg/L	0.1 mg/kg		
Comme	ents:									
00111110	_									
	_									
	_									
										
Attachme	nts:									
	_									
	_									

0530

General Site Assessment Data

	high value (ft bgs):	<u>30</u>			<u>-</u> _
	Unknown:				
Flow direction		<u>sw</u>			
Horizontal hydraulic gr	adient (feet/foot):	0.03			Unknow
Vertical hydraulic gradi	ent (feet/foot):				Unknow
K range (ft/day)	Measure	d using: _	Slug Test	Laboratory	Field data
	low				<u>x</u> Unknow
	high				
Transmissivity (ft2/day)): Measure	d using:	Slug Test	Laboratory	Field data
	low	1.10E-05			Unknow

<u>X</u>

Attachments:

The	rmal Treatment - Design								Fac	cility ID#:	0530	<u>)</u>
<u>x</u>	Thermal treatment:		_ Conduct	tive								
			_ Electrica	al Resistance								
		<u>x</u>	Steam	3 phase		6 phase		_AC power		D	C power	
		-	_	Steam		_Steam + air		_ Steam + O	2			
	Towns of Took	D:1		lescribe)	1.0.							
<u>x</u>	Type of Test: <u>x</u>	Pilot		<u></u>	ll-scale System		مريماما		. م م ام	d:to		
X	Geology of Treatment Zone	9:	_	Relativel Largely i Largely i Compete	ly homogene permeable se impermeable ent, but fractu	ous and permea ous and impermed ediments with into sediments with ured bedrock (i.e limestone, sands	eable er-bed inter-b . crysta	unconsolida ded lenses edded laye	ated s	sediments wer perm	eability n	
<u>x</u>	Treatment Targe Zone:		Saturat	ed only	Vado	ose only	<u>x</u>	Both (Satu	rated	and Vados	se zones)	
<u>x</u>	Start of Thermal Test:	9/1/2	2002			Duration:	83 d					
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No								
<u>x</u>	Treatment Cell Design: Size of target zone (ft2):				7500			Unk	nown	(50 x	150 ft)
	Thickness of target zone (fi	۴۱۰			100			· ·	nown		<u>00</u> x	<u>100</u> It)
	Depth to top of target zone		ic).		0			· ·	nown			
	Thickness of target zone be		•	le (ft):	<u>∪</u> 70 to 80				nown			
	Number of energy delivery			ie (it).	· ·			Unk				
	Number of extraction points		5.		<u>9</u> <u>7</u>			Unk				
<u>x</u>	Temperature Profile:											
_	Initial formation temperatur	e (de	a C):			<u>7</u>				Unknov	vn	
	Maximum representative for		- '	erature (deg (C)·	<u>25</u>				Unknov		
	Time to reach maximum re		-			<u>83</u>				Unknov		
	Duration of treatment at rep	-				<u>1</u>				Unknov		
	Duration of treatment at rep	J16361	itative te	imperature (c	iays).	1				Clikilov	VII	
	Formation temperature imn	nedia	telv post-	-treatment:		<u>Dat</u>	<u>e</u>			Temperat	ture (deg	<u>C)</u>
	Formation temperature pos				nt 1:							
	Duration of post-treatment			_					_			
<u>x</u>	Mass of contaminant remove	ved:										
	Via I	iquid	pumping	:	3.3			_ lb	<u>x</u>	kg		Unknow
	In va	apor s	tream:		4.03			_ lb	<u>x</u>	kg		Unknow
	Tota	ıl:			7.36				<u>x</u>	kg	_	Unknow
	Comments:											
								_				
	Attachments:											

Cos	at and Performance			Facility ID#: 0530
	_ Performance			
	Remediation Goal:			
		_ In Groundwater:		
		_ In Soil:		
	Mar tha Damadiatia	- OI A-bi		
	Was the Remediatio			
		_ In Groundwater		
		Comment:		
		_ In Soil		
		Comment:		
	General comments	on the thermal appli	cation:	
	Objective - Imp	proving the understa	anding of mechanisms o	ontrolling DNAPL an ddissolved phase contaminant behavior in
	fractured bedro	ock, evaluating how	a remedation technolog	y could be successfully implemented and controlled in fractured
			aminants in the subsurfa ed bedrock systems.	ace to reduce overall remediation timeframe, and evaluating
		Demobilization cos	sts are not included in the	ne cost below.
	Lessons Learned			
	F			
<u>X</u>	Energy	445.0	2	x kWhrkWhr/m³kWhr/yd³
	Total Energy Used:	445.0	_	-
	-	al energy applied to	treatment zone:	
	<u>x</u> Oth	er energy:		87.78 kWhr/m ³ kWhr/yd ³
		<u>x</u> Pleas	e note other energy:	extracted steam energy
<u>x</u>	Cost			
_	Total Project Cost:		1918850	
	-	nsultant Cost:		
		ermal Vendor Cost:	863000	
	-	ergy Cost:	<u>500000</u>	m³ yd³
		ner Cost 1:	375800	
		ner Cost 1:		
	-		<u>426050</u>	
		ner Cost 3:	<u>254000</u>	Observation in the
	x Please note ot	•	x Other Cost 1:	<u>Characterization</u>
		:	x Other Cost 2:	construction and operation
			<u>x</u> Other Cost 3:	post-sampling, reporting, and miscellaneous

<u>x</u> PD ____ File Analyzed By: Date: 10/30/2006 ____ERH ____Steam Type of treatment: ___ Conductive Hot air _____Pesticides Type of Contaminant: _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: 1/16/1996 End of Test: Mar-98 Duration: 2 years Type of Site: Non-DOD __ DoD Facility Name: Union Chemical Company Superfund Site Address: City, State, Zip Code: South Hope, ME OU# or Site #: _ Primary point of contact: Terrence Connelly Organization: **EPA** Address: 1 Congress Street, Suite 110 City, State, Zip Code: Phone #: 617-918-1373 email: connelly.terry@epa.gov Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0532

General Site Information

___ Hydraulic Conductivity information

Gener	al Site Ass	sessment Data					Facility II	D#: <u>0532</u>
Impacted Zone: Length (parallel to flow direction)(ft.): Impacted zone as defined by documentatio Alternative method for determining size of it			as defined by documentation			ness (ft):	_	Unknown
		Map attachment	=	pacieu zone (dee sou	nce zone deminion anacimien	no)		
χ Monitor Wells: Number of relevant monitoring wells with groundwater data: Pre-treatment: 28 Post-treatment:								None
		Number of wells relat	tive to treatment zone:					
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Soil Boring	s: Number of relevant so	oil borings with pre-treatment	data:				
			oil borings with post-treatmen					
		Number inside treatme	ent zone:	_ Number o	outside treatment zone:			
,	Types of C	Contaminants						
— '	ypes or C	oritariiriarits						
					Average Pre-treatme Chem			ent Concentration per nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	o-xylene		None	None	None	None
	nicals of ncern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
	Comme	nts:	·	·	<u> </u>	·	·	
								
A	Attachmen	ts:						

Hydrogeologic Conceptu	ıal Model		Facility ID#: 05	32
Hydrogeologic Conceptu Geology:	ial Model Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of	sediments ed sediments f lower permeability material of higher permeability material sediments ed sediments f lower permeability material	32
Ground surface ele		Largely impermeable sediments with inter-bedded layers Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl	Unknown	
Is more than 1 aqu	ifer present?	No Yes (number):	Unknown (assume single aquifer)	
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3	_ _ _	
Flow direction			_	
Horizontal hydraulic g	c gradient (feet/foot):		Unknown	
K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data	
Transmissivity (ft2/	high (day): Measured low high	using: Slug Test Laboratory	Field data Unknown	
Comments:				<u>-</u>
Attachments:				_

Ther	mal Treatment - Design						Facility ID#:	0532
<u>x</u>	Thermal treatment:	Conductive						
		Electrical Res	sistance					
			phase	6 phase	÷	AC power	DC	power
		Steam _	Steam	Steam -	+ air	Steam + O2		
		x Other (descri		Hot air		Steam + O2		
<u>x</u>	Type of Test:	Pilot test		cale System				
^	Geology of Treatment Zone	<u>-</u>	=	nomogeneous and	l nermeah	le unconsolidated	l sadiments	
	Coology of Trodumont Zone			nomogeneous and				
			-	meable sediments	•			ability material
				ermeable sedime			•	-
				, but fractured bed			or migner pen	neability material
			-	bedrock, limeston				
	Treatment Targe Zone:	Saturated or		Vadose only		Both (Satura	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	16-Jan-96	,		Ouration:			
~	Hydraulic Control		No	-		<u>2 y 0 415</u>		
	,							
	Treatment Cell Design:							
	Size of target zone (ft2):					Unkn	own (_ x ft)
	Thickness of target zone (fi	t):				Unkn	own	
	Depth to top of target zone					Unkn	own	
	Thickness of target zone be		:			Unkn	own	
	Number of energy delivery			91		Unkn		
	Number of extraction points			30		Unkn		
				<u></u>				
	Temperature Profile:							
	Initial formation temperatur	e (deg C):					Unknown	
	Maximum representative for	ormation temperatur	re (deg C):				Unknown	
	Time to reach maximum re	presentative tempe	rature (day	/s):			Unknown	
	Duration of treatment at reg						Unknown	
	·	•						
					Date	!	Temperatu	re (deg C)
	Formation temperature imn	nediately post-treat	ment:					
	Formation temperature pos	st-treatment monitor	ring event	1:				
	Duration of post-treatment	monitoring (days):						
	Mass of contaminant remove	ved:						
	Via I	liquid pumping:				lb	kg	Unknown
	In va	apor stream:				lb	kg	Unknown
	Tota	•				lb	kg	Unknown
					_			
	Comments:							
	Attachments:							

and Performance					Facility ID#:	0532
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_	·					
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k¹	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:			_ !:••••	күүшүүс
	1 lease	note office energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
 Th	ermal Vendor Cost:					
	ergy Cost:			m³	_ yd³	
	her Cost 1:				_ / =	
	her Cost 1:	-				
	her Cost 3:					
Oil		Other Cost 1:				
riease note of		Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

General Site Information Facility ID#: 0535 File Analyzed By: PD ____ Date: 9/18/2006 Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: _Active Post Type of Test: Pilot Test Full Scale System Start of Test: 1995 End of Test: 2001 Duration: 59 months Type of Site: Non-DOD _ DoD Facility Name: Bell Lumber and Pole Company Address: City, State, Zip Code: New Brighton, MY OU# or Site #: Primary point of contact: Lyle Johnson Organization: Western Research Institute Address: 365 N. 9th St. City, State, Zip Code: Laramie, WY 82072 Phone #: 307-721-2281 email: lylej@uwyo.edu Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

x Impacted Zone: Length (parallel to flow direction)(ft.): bclow Width (ft): Thickness (ft): U x Impacted zone as defined by documentation							Unknown	
		od for determining size of im		ed zone (See source z	cone definition attachmen	its)		
Monitor W	Vells: Number of relevant m	nonitoring wells with ground	water	data:				None
	Pre-treatment: Post-treatment:							
	Number of wells relative to treatment zone:							
	Pre-treatment In: Upgradient: Downgradient: Crossgradient:							
Post-treatment In: Upgradient: Downgradient: Crossgradient:								
x Soil Boring	gs: Number of relevant so	il borings with pre-treatment	t data	: <u>22</u>				
	Number of relevant so	il borings with post-treatmer	nt dat	a:				
	Number inside treatme	ent zone:	_	Number outsid	de treatment zone:			
x Types of C	Contaminants	T	1				T	
					Average Pre-treatme	nt Concentration per nical:		ent Concentration per nical:
ı————	Chlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	<u>x</u>	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel	<u>x</u>	PCP	None	None	None	None
	1,1-dichloroethene	Napthalene	<u>x</u>	Fuel Oil	None	None	None	None
	cis-1,2-dichloroethene	Benzene			None	None	None	None
	trans-1,2-dichloroethene	Tolune			None	None	None	None
	1,1-dichloroethane	Ethylbenzene			None	None	None	None
	1,2-dichloroethane	m/p-xylene			None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene			None	None	None	None
Concern	1,1,2-trichloroethane				None	None	None	None
	1,1,2,2-tetrachloroethane				None	None	None	None
	Vinyl Chloride				None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
Commer	Comments:							
	2 acres impacted							
Attachmen	its:							

0535

General Site Assessment Data

Нус	drogeologic Conceptua	l Model	Facility ID#: 05						
<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>						
		Vadose Zone:	Relatively homogeneous and permeable uncons	solidated sediments					
			Relatively homogeneous and impermeable unco	onsolidated sediments					
			\underline{x} Largely permeable sediments with inter-bedded	lenses of lower permeability material					
			Largely impermeable sediments with inter-bedded layers of higher permeability material						
			Competent, but fractured bedrock (i.e. crystalline	e rock)					
			Weathered bedrock, limestone, sandstone						
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments						
			Relatively homogeneous and impermeable unconsolidated sediments						
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material						
	Largely impermeable sediments with inter-bedded layers of higher permeability materia								
			Competent, but fractured bedrock (i.e. crystalline	e rock)					
			Weathered bedrock, limestone, sandstone						
<u>x</u>	Ground surface elev	ration based on wells in	or adjacent to treatment zone: ft	amsl <u>x</u> Unknown					
<u>x</u>	Aquifer Characterist	ics:							
	Is more than 1 aquif	er present?	No Yes (number):	Unknown (assume single aquifer)					
			Aquifer 1 Aquifer 2 A	Aquifer 3					
	Depth to water:	low value (ft bgs):	<u>10</u>						
		high value (ft bgs):	<u></u>						
		Unknown:							
<u>x</u>	Flow direction		<u>SW</u>						

K range (ft/day)	Measured using:	Slug Test	Laboratory	Field data
	low <u>3.1(10^-3) cm</u>	<u></u>		Unknown
	high <u>9.5(10^-3) cm</u>	<u></u>		
Transmissivity (ft2/day):	Measured using:	Slug Test	Laboratory	Field data
	low			Unknown
	high			

0.004

Comments:

Attachments:

<u>x</u>

Horizontal hydraulic gradient (feet/foot):

Vertical hydraulic gradient (feet/foot):

Confining layer K=1(10^-7)cm/s

to 0.6 ft/dy

___ Unknown

___ Unknown

Radial velocity is 0.1

Ther	rmal Treatment - Design					Facility ID#:	<u>0535</u>
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Resistance					
		3 phase		6 phase	AC power	DC	power
		x Steam Hot water	<u>r</u>				
		Steam		Steam + air	Steam + O	2	
		Other (describe)					
<u>x</u>	Type of Test:	Pilot test <u>x</u> Ful	ll-scale System	l			
<u>x</u>	Geology of Treatment Zone	e: Relative	ly homogene	ous and permeal	ble unconsolidate	d sediments	
		Relative	ly homogene	ous and imperme	eable unconsolida	ated sediments	
		<u>x</u> Largely μ	permeable se	diments with inte	er-bedded lenses	of lower permea	ability material
		Largely i	mpermeable	sediments with i	inter-bedded laye	rs of higher pern	neability material
		Compete	ent, but fractu	red bedrock (i.e.	. crystalline rock)		
		Weather	ed bedrock, I	imestone, sands	tone		
<u>x</u>	Treatment Targe Zone:	x Saturated only	Vado	ose only	Both (Satu	rated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	<u>1995</u>		Duration:	59 months		
	_ Hydraulic Control	Yes No					
<u>x</u>	Treatment Cell Design:						
	Size of target zone (ft2):		<u>26136</u>		Unk	nown (x ft)
	Thickness of target zone (f	it):			<u>x</u> Unk	nown	
	Depth to top of target zone	(ft bgs):			<u>x</u> Unk	nown	
	Thickness of target zone be	elow water table (ft):			<u>x</u> Unk	nown	
	Number of energy delivery		<u>6</u>		Unk	nown	
	Number of extraction points	s:	<u>1</u>		Unk	nown	
v	Tomporatura Profile:						
<u>x</u>	Temperature Profile: Initial formation temperatur	re (dea C):				<u>x</u> Unknown	
	•	ormation temperature (deg	C)·	<u>54</u>		Unknown	
		epresentative temperature (<u>450</u>		Unknown	
		presentative temperature (c		450		<u>x</u> Unknown	
		μ· · · · · · · · · · · · · · · ·	, -,-				
				Date	<u>e</u>	Temperatur	re (deg C)
	Formation temperature imm	mediately post-treatment:				·	
	Formation temperature pos	st-treatment monitoring eve	nt 1:				
	Duration of post-treatment	monitoring (days):					
<u>x</u>	Mass of contaminant remove	ived:					
	Via I	liquid pumping:			lb	kg	Unknown
	In va	apor stream:			lb	kg	Unknown
	Tota	al:	500,00	<u>00</u>	<u>x</u> lb	kg	Unknown
	·	110veu – 00, 100 yallotis					
	Comments:						
	Attachmenter						
	Attachments:						
				·			

st and Performance				Facility ID#:	<u>0535</u>
_ Performance					
Remediation Goal:					
In Groundwa	iter:				
In Soil: —					
Was the Remediation Goal Achieve	ed:				
In Groundwa	iter				
	· · ·				
In Soil					
	ent:				
Comme					
Project did not achieve design the impacted zone Lessons Learned	n flow rates or temperature.	Organic production	on exceeded exp	retations. Only	/ treated upper
the impacted zone	n flow rates or temperature.	Organic production	on exceeded exp	retations. Only	/ treated upper
the impacted zone Lessons Learned	n flow rates or temperature.	Organic production	on exceeded exp		
the impacted zone Lessons Learned			kWhr/m ³		Vhr/yd ³
the impacted zone Lessons Learned			kWhr/m³	3 kV	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned			kWhr/m³	3 kV kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned	ed to treatment zone:		kWhr/m³	3 kV kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned	ed to treatment zone:		kWhr/m³	3 kV kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned	ed to treatment zone:		kWhr/m³	3 kV kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned	ed to treatment zone:		kWhr/m³	3 kV kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned	ed to treatment zone:		kWhr/m³	3 kV kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned	ed to treatment zone:		kWhr/m ³	3kW kWhr/m ³ kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned Energy Total Energy Used: Total energy applie Other energy: P Cost Total Project Cost: Consultant Cost: Thermal Vendor Cost: Energy Cost:	ed to treatment zone:		kWhr/m ³	3kW kWhr/m ³ kWhr/m ³	
the impacted zone Lessons Learned Energy Total Energy Used: Total energy applie Other energy: P Cost Total Project Cost: Consultant Cost: Thermal Vendor Cost: Energy Cost: Other Cost 1:	ed to treatment zone:		kWhr/m ³	3kW kWhr/m ³ kWhr/m ³	Vhr/yd³ kWhr/
the impacted zone Lessons Learned	ed to treatment zone:		kWhr/m ³	3kW kWhr/m ³ kWhr/m ³	Vhr/yd ³ kWhr/
the impacted zone Lessons Learned Energy Total Energy Used: Total energy applie Other energy: P Cost Total Project Cost: Consultant Cost: Thermal Vendor Cost: Thermal Vendor Cost: Other Cost 1: Other Cost 2: Other Cost 3:	ed to treatment zone:		kWhr/m ³	3kW kWhr/m ³ kWhr/m ³	Vhr/yd ³ kWhr/

<u>X</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/26/2006
	Type of treatment:	Conductive		_Steam	ERH	<u>x</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	Chlorinated Solv	ents	<u>X</u>	Petroleum Hye	drocarbo	ons	Pesticides	S
		Wood Treating		-	Other:				
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	<u>x</u> Pilot Test		Full Scale	System				
	Start of Test:	2/18/1998		End	of Test: <u>8/21/199</u>	98		Duration: 185	<u>days</u>
	Type of Site:	<u>x</u> Non-DOD		_DoD					
<u>x</u>	Facility Name: Mobil Oil								
	Address:								
	City, State, Zip Code:	MN							
	OU# or Site #:								
<u>x</u>	Primary point of contact:	Ray Kasevich							
	Organization: KSN Energ	gies							
	Address: 291 Main St., 3r	rd Floor, PO Box 612							
	City, State, Zip Code:	Great Barrington, MA	0123	0					
	Phone #: 413-528-4651			email: rkas	sevich@ksnenerg	gies.com	1		
	Other contacts or vendors wh	no worked on site			None				
	Point of contact:								
	Type:Vendor, Co	onsultant	_Ven	dor, Techni	cal Applications		Otl	ner	
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:			email:					
_	A/OC								
Q,	A/QC								
	Characteristics of Interest								
	Good pre- and post-trea				Good pr	o and r	ost treatme	nt soil data	
	Good pre- and post-trea	-	•		Good pr	_		in son uata	
	Groundwater elevation				Flux ass				
	Hydraulic Conductivity				Geologi	C C1USS-1	SCHOII		
	Hydraune Conductivity	y mnormanon							

0540

General Site Information

Impacted Zone: Length (parallel to flow direction)(ft.): Impacted zone as defined by documentation			Width (ft):	Thick	cness (ft):	_	Unknown	
		od for determining size of im		one definition attachmer	nts)			
	Map attachment							
X Monitor Wells: Number of relevant monitoring wells with groundwater data:								
			Pre-treatment:	<u>11</u>	Post-treatment:	<u>11</u>		
	Number of wells relat	ive to treatment zone:						
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
x Soil Boring		il borings with pre-treatment						
	Number of relevant so	il borings with post-treatmer	nt data: 10					
	Number inside treatme	ent zone:	_ Number outsid	e treatment zone:				
x Types of C	Contaminants		1					
					ent Concentration per		ent Concentration per	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Cher Groundwater (mg/L)	nical: Soil (mg/kg)	Cher Groundwater (mg/L)	mical: Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None None	None None	None	None	
	Tetrachloroethene	Jet Fuel	Creasure	None	None	None	None	
	1,1-dichloroethene	Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	Benzene		None	None	None	None	
	trans-1,2-dichloroethene	Tolune		None	None	None	None	
	1,1-dichloroethane	Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	m/p-xylene		None	None	None	None	
	1,1,1-trichloroethane	o-xylene		None	None	None	None	
Chemicals of Concern	1,1,2-trichloroethane	x GRO		100 mg/L	100 mg/kg	100 mg/L	50 mg/kg	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
Comme	nts:							
Attachmer	nte:							
Allacilliei								

0540

General Site Assessment Data

	O a alla avvi	7	Harris Mala d O all reside					
<u>x</u>	Geology:	Zone	Unconsolidated Sediments					
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments					
			Relatively homogeneous and impermeable unconsolidated sediments					
			<u>x</u> Largely permeable sediments with inter-bedded lenses of lower permeability material					
			Largely impermeable sediments with inter-bedded layers of higher permeability material					
			Competent, but fractured bedrock (i.e. crystalline rock)					
			Weathered bedrock, limestone, sandstone					
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments					
			Relatively homogeneous and impermeable unconsolidated sediments					
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material					
Largely impermeable sediments with inter-bedded layers of higher perme								
			Competent, but fractured bedrock (i.e. crystalline rock)					
			Weathered bedrock, limestone, sandstone					
	Ground surface eleva	tion based on wells in o	r adjacent to treatment zone: ft amsl Unknown					
<u>x</u>	Aquifer Characteristic	s:						
	Is more than 1 aquife	r present?	No Yes (number): Unknown (assume single aquifer)					
			Aquifer 1 Aquifer 2 Aquifer 3					
	Depth to water:	low value (ft bgs):	30					
		high value (ft bgs):						
		Unknown:						
	Flow direction							
	-							
	_ Horizontal hydraulic g	radient (feet/foot)	Unknown					
	Vertical hydraulic grad		Unknown					
	vertical flydraulic grai	dient (reconoct).	UIRIOWII					
v	K range (ft/day)	Measured	using: Slug Test Laboratory Field data					
<u>x</u>	K range (Irday)	low						
		high	<u>Unknown</u>					
	T	9	Charles Charles I I I I I I I I I I I I I I I I I I I					
	Transmissivity (ft2/da		· — · — · —					
		low	Unknown					
		high						
	Comments:							
	<u>K = </u>	0.019 cm/sec						
	Attachments:							

0540

Hydrogeologic Conceptual Model

The	rmal Treatment - Design					Facility ID#:	<u>0540</u>	
<u>x</u>	Thermal treatment:	Conductive						
		Electrical Re	esistance					
			3 phase	6 phase	AC pov	wer DO	C power	
		Steam						
			Steam	Steam + ai	r Steam	+ O2		
		X Other (descr	ribe) <u>RF</u>	<u>H</u>				
<u>x</u>	Type of Test:	Pilot test	x Full-scale	System				
<u>x</u>	Geology of Treatment Zon	ie:	Relatively hon	nogeneous and pe	rmeable unconsolid	lated sediments		
		Relatively hon	nogeneous and im	permeable unconso	olidated sediments			
		<u>x</u>	Largely perme	able sediments w	th inter-bedded lens	ses of lower perme	eability material	
			Largely imperi	meable sediments	with inter-bedded la	ayers of higher per	meability material	
			Competent, bu	ut fractured bedroo	ck (i.e. crystalline ro	ck)		
			Weathered be	drock, limestone,	sandstone			
<u>x</u>	Treatment Targe Zone:	Saturated of	only <u>x</u>	Vadose only	Both (S	Saturated and Vadose	e zones)	
<u>x</u>	Start of Thermal Test:	2/18/1998		Dur	ation: <u>185 d</u>			
	_ Hydraulic Control	Yes	No					
<u>x</u>	Treatment Cell Design:							
	Size of target zone (ft2):				t	Jnknown (_ x ft)	
	Thickness of target zone (ft):	<u>10</u>			Jnknown		
	Depth to top of target zone	e (ft bgs):	<u>20</u>			Jnknown		
	Thickness of target zone below water table (ft):					Unknown		
	Number of energy delivery	points:	<u>3</u>		t	Jnknown		
	Number of extraction point	ts:	<u>10</u>			Jnknown		
<u>x</u>	Temperature Profile:							
	Initial formation temperature (deg C):			<u>15.5</u>		Unknow		
	Maximum representative f	ormation temperatu	ure (deg C):	-		Unknow	n	
	Time to reach maximum representative temperature					Unknow	n	
	Duration of treatment at re			Unknow	n			
					Date	Temperati	ure (deg C)	
	Formation temperature im-				<u>2.0 (0.0 g 0,</u>			
	Formation temperature post-treatment monitoring event 1:							
	Duration of post-treatment monitoring (days):							
	, , , , , , , , , , , , , , , , , , , ,	3 (11) 1,						
<u>x</u>	Mass of contaminant remo	oved:						
_	Via	liquid pumping:			lb	kg	Unknow	
	In vapor stream:				lb	kg	Unknow	
	Tota	•		2305	lb	<u>x</u> kg	Unknow	
	Comments:							
	300 yd3	- treated (or 11	6 yd3 per RF	well x 3 wells =	~348 yd3 treated)			
	Attachments:							

Cost and Performance Facility ID#: 0540

Performance					
Remediation Goals	: <u> </u>				
_	In Groundwater: —				
	_				
<u>x</u>	In Soil: 1) red	luce residual soil concer	trations to remove o		2) decrease remediation
Was the Remediat	tion Goal Achieved:				
	In Groundwater				
	Comment: —				
	_				
_	In Soil				
	Comment: —				
	_				
General comments	s on the thermal applica	ition:			
-					
_ Energy					
Total Energy Used	l:		kWhr	kWhr/m³	kWhr/yd ³
т	otal energy applied to tr	reatment zone:		kWh	r/m³ kWhr/yd³
0	Other energy:			kWh	r/m ³ kWhr/yd ³
	Please i	note other energy:			_
_ Cost					
Total Project Cost:					
·	Consultant Cost:				
· · · · · · · · · · · · · · · · · · ·	hermal Vendor Cost:			3 .3	
	nergy Cost:		r	n ³ yd ³	
	Other Cost 1:				
	Other Cost 2:				
	other Cost 3:	Other Cost 4:			
Please note	omer cost:	Other Cost 1:			
	_	Other Cost 2:			
		Other Cost 3:			

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	10/30/2006
	Type of treatment:	Conductive	Steam	ERH <u>x</u>	Other:		
	Type of Contaminant:	Chlorinated Solve	ents <u>x</u>	Petroleum Hydrocarb	ons	Pesticides	
		Wood Treating		Other:			
	Treatment Status:	Active	\underline{x} Post				
	Type of Test:	Pilot Test	x Full Sca	le System			
	Start of Test:		Enc	d of Test:		Duration:	
	Type of Site:	<u>x</u> Non-DOD	DoD				
<u>x</u>	Facility Name: Ashland R	<u>efinery</u>					
	Address:						
	City, State, Zip Code:	St. Paul, MN					
	OU# or Site #:						
<u> </u>	Primary point of contact:	Ray Kasevich					
	Organization: KSN Energ	gies					
	Address: 291 Main St., 3r	rd Floor, PO Box 612					
	City, State, Zip Code:	Great Barrington, MA	01230				
	Phone #: 413-528-4651		email: rk	asevich@ksnenergies.con	<u>1</u>		
<u> </u>	Other contacts or vendors wh	no worked on site		None			
	Point of contact: <u>Dani</u>	iel Berg					
	Type: Vendor, Co	onsultant	Vendor, Techr	nical Applications	Othe	er	
	Organization: MN Pollut	ion Control Agency					
	Address:						
	City, State, Zip Code:						
	Phone #: 651-296-0550 email: daniel.berg#pca.state.mn.us						
Q/	A/QC						
	Characteristics of Interest						
	_			Good pre- and r	ost-treatment	t soil data	
		-				c son unu	
							
	· 			Geologic closs-	section		
	Good pre- and post-tre Good temperature prof Groundwater elevation Hydraulic Conductivity	file vs. time information		Good pre- and p	t	t soil data	

0545

General Site Information

General Site Assessment Data						Facility II	D#: <u>0545</u>
		v direction)(ft.):			ness (ft):		Unknown
	Alternative meth		pacted zone (See source zo	ne definition attachmer	nts)		
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy			Deather to the second		None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	t data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
Types of 0	Contaminants						
				Average Pre-treatme	ent Concentration per	Average Post-treatme	ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	nts:						
							
Attachmer	nts:						

Hyd	rogeologic Conceptual	l Model		Facility ID#:	0545						
	_ Geology:	<u>Zone</u>	Unconsolidated Sediments								
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated so	ediments							
			Relatively homogeneous and impermeable unconsolidated	sediments							
			Largely permeable sediments with inter-bedded lenses of I	ower permeability material							
			Largely impermeable sediments with inter-bedded layers o	f higher permeability materia	al						
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated se	ediments							
			Relatively homogeneous and impermeable unconsolidated	sediments							
			Largely permeable sediments with inter-bedded lenses of I	ower permeability material							
			Largely impermeable sediments with inter-bedded layers o	f higher permeability materia	al						
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
	_ Ground surface eleva	ation based on wells in o	adjacent to treatment zone: ft amsl	Unknown							
	_ Aquifer Characteristi	cs:									
	Is more than 1 aquife	er present?	No Ves (number): U	Jnknown (assume single aquife	r)						
			Aquifer 1 Aquifer 2 Aquifer 3								
	Depth to water:	low value (ft bgs):		_							
		high value (ft bgs):		_							
		Unknown:		_							
	_ Flow direction			-							
	_ Horizontal hydraulic	gradient (feet/foot):		Unknown							
	Vertical hydraulic gra	adient (feet/foot):		Unknown							
	_ K range (ft/day)	Measured	using: Slug Test Laboratory	Field data							
		low		Unknown							
		high		-							
	Transmissivity (ft2/da	ay): Measured	using: Slug Test Laboratory	Field data							
		low		Unknown							
		high		-							
	Comments:										
					_						
	_										
	Attachments:										

The	rmal Treatment - Design				Facility ID#:	<u>0545</u>
<u>x</u>	Thermal treatment:	Conductive				
		Electrical Resistance				
		3 phase	6 phase	AC power	DC	power
		Steam				
		Steam	Steam + air	Steam + C)2	
	:	X Other (describe)	<u>RFH</u>			
<u>x</u>	Type of Test:	Pilot test <u>x</u> Full	-scale System			
	_ Geology of Treatment Zone:	Relatively	homogeneous and perm	neable unconsolidate	ed sediments	
			homogeneous and impe			
			ermeable sediments with		-	-
			npermeable sediments w			eability material
			nt, but fractured bedrock			
		·	ed bedrock, limestone, sa			
	_	Saturated only	Vadose only		irated and Vadose	zones)
	_ Start of Thermal Test:		Durati	on:		
	_ Hydraulic Control	Yes No				
	_Treatment Cell Design:					
	Size of target zone (ft2):				known (x ft)
	Thickness of target zone (ft):				known	
	Depth to top of target zone (known	
	Thickness of target zone bel			Unl		
	Number of energy delivery p				known	
	Number of extraction points:			Unl	known	
	Tomporatura Profile:					
	_ Temperature Profile:	(dog C):			I Indonesia	
	Initial formation temperature				Unknown	
	Maximum representative for				Unknown	
	Time to reach maximum rep		•		Unknown	
	Duration of treatment at repr	esentative temperature (da	ays):		Unknown	
			,	Date	Temperatur	o (dog C)
	Formation temperature imme	adiately post-treatment:	<u>.</u>	<u>Date</u>	remperatur	e (ueg o)
	Formation temperature immers Formation temperature post-					
	Duration of post-treatment m	_			-	
	buration of post treatment if	ioriiioriiig (days).				
	_ Mass of contaminant remove	eq.				
	_	uid pumping:		lb	kg	Unknow
		or stream:		lb	kg	Unknow
	Total:			lb	kg	Unknow
	i otai.				<u> </u>	CHAIGW
	Comments:					
	Attachments:					

and Performance					Facility ID#:	<u>0545</u>
Performance						
Remediation Goal:	_					
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
						
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Whr/yd ³
To	tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd
	her energy:				_ kWhr/m³	kWhr/yd
		note other energy:				
	110000	note enter energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
Th	ermal Vendor Cost:					
En	ergy Cost:			m ³	_ yd³	
	her Cost 1:				_ , -	
	her Cost 2:					
	her Cost 3:					
Please note of		Other Cost 1:				
Please note of	iner cost:	Other Cost 1:				
		Other Cost 2:				

<u>x</u> PD ____ File Analyzed By: Date: 10/30/2006 Type of treatment: ___ Conductive ____ Steam ERH **RFH** Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ___ Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: End of Test: <u>3/31/1996</u> 3/1/1996 Duration: 30 days Type of Site: __ DoD Non-DOD Facility Name: Confidential Gasoline Service Station Address: City, State, Zip Code: St. Paul, MN OU# or Site #: Primary point of contact: Ray Kasevich Organization: KAI Technologies Address: City, State, Zip Code: Phone #: email: ____ Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0550

General Site Information

___ Hydraulic Conductivity information

General Site As	sessment Data					Facility II	D#: <u>0550</u>
Impacted		v direction)(ft.): s defined by documentation		Thick	ness (ft):		Unknown
		•	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment		paoloa 20110 (000 00a100 20	no dominion diadomino	,		
	 -						
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy	vater data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	ive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
Types of C	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
				•		•	
Attachmer	nts:						

Hydrogeologic Conceptual	I Model		Facility ID#: 0550
Hydrogeologic Conceptual Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated segments. Relatively homogeneous and impermeable unconsolidated segments with inter-bedded lenses of I Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated segments with inter-bedded lenses of I Largely permeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock)	ediments I sediments ower permeability material of higher permeability material ediments I sediments ower permeability material
Ground surface elev Aquifer Characteristi Is more than 1 aquife	ics:	Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl No Yes (number): U Aquifer 1 Aquifer 2 Aquifer 3	Unknown Jnknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquilet 2 Aquilet 3	- - -
Flow direction			_
Horizontal hydraulic Vertical hydraulic gra			Unknown
K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data Unknown
Transmissivity (ft2/da	high	using:Slug TestLaboratory	Field data Unknown
Comments:			
Attachments:			

Thermal treatment:	Conducti	ive			
	T-1	1 Danier			
	Electrica	l Resistance	6 phase	A.C	DC
		3 phase	6 phase	AC power	DC power
	Steam	Stoom	Stoom Loir	Stoom + O2	
	x Other (de	Steam	Steam + air	Steam + O2	
Type of Test:	<u>-</u>	escribe) <u>RF</u> Full-scale			
_ Geology of Treatment	_	· · · · · · · · · · · · · · · · · · ·	nogeneous and permeabl	e unconsolidated s	ediments
_ declogy of Treatment			nogeneous and impermea		
		-	-		lower permeability materia
					of higher permeability mate
			ut fractured bedrock (i.e.		g,
	· ·		drock, limestone, sandsto		
_ Treatment Targe Zone					ed and Vadose zones)
Start of Thermal Test:		, _	Duration:		,
_ Hydraulic Control	Yes	No			
- /					
_ Treatment Cell Design	n:				
Size of target zone (ft2	2):			Unknow	vn (x
Thickness of target zo	ne (ft):			Unknow	vn
Depth to top of target	zone (ft bgs):			Unknow	vn
Thickness of target zo	ne below water table	e (ft):		Unknow	vn
Number of energy deli	ivery points:			Unknow	vn
Number of extraction p	points:	_		Unknow	vn
_ Temperature Profile:					
Initial formation tempe	erature (deg C):				Unknown
Maximum representati	ive formation tempe	rature (deg C):			Unknown
Time to reach maximu	ım representative te	mperature (days)	:		Unknown
Duration of treatment	at representative ter	mperature (days):			Unknown
			Date		Temperature (deg C)
Formation temperature	e immediately post-t	reatment:			
Formation temperature	•	-	-		
Duration of post-treatn	nent monitoring (day	/s):			
Mana of contouringut.					
_ Mass of contaminant r				11.	I. II.l.
	Via liquid pumping:			lb	kg Unk
	In vapor stream:			lb	kgUnk
	Total:			lb	kg Unk
Comments:					
Johnnello.					
37 vr	d3 treated				

and Performance					Facility ID#:	<u>0550</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_	·					
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
-						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k۱	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:				күүшүүс
	1 lease	note other energy.	-			
Cost						
Total Project Cost:						
Co	nsultant Cost:					
 Th	ermal Vendor Cost:					
	ergy Cost:			m³	_ yd³	
	her Cost 1:				_ / =	
	her Cost 1:	-				
	her Cost 3:					
		Other Cost 1:				
Please note of		Other Cost 1:				
		Other Cost 2:				

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	9/13/2006
	Type of treatment:	x Conductive	Steam	ERH	Other:		
	Type of Contaminant:	Chlorinated Solv	vents	Petroleum Hydrocarl	oons	Pesticides	
	,,	Wood Treating	<u>x</u>	Other: PCBs			
	Treatment Status:	Active	x Post				
	Type of Test:	x Pilot Test	Full Scale	e System			
	Start of Test:	Apr-97		of Test: Jul-97		Duration: varied	i
	Type of Site:	<u>x</u> Non-DOD	DoD				
<u>x</u>	Facility Name: Missouri E	Electric Works					
	Address: Missouri S	State Route 61					
	City, State, Zip Code:	Cape Girardeau, MO					
	OU# or Site #: CERCLIS	ID Number: MOD9809	65982				
<u>x</u>	Primary point of contact:	Pauletta France-Isetts,	RPM				
	Organization: US EPA R	Region 7					
	Address: 726 Minnesota A	Ave.					
	City, State, Zip Code:	Kansas City, KS 6610	<u>1</u>				
	Phone #: 913-551-7701		email: fran	nce-isetts.pauletta@epa.	gov		
<u>x</u>	Other contacts or vendors wh	ho worked on site		None			
	Point of contact: Ralp	oh Baker					
	Type: <u>x</u> Vendor, C	onsultant	_ Vendor, Techni	cal Applications	Other	·	
	Organization: <u>TerraTherra</u>	<u>m</u>					
	Address: 10 Stevens Rd.						
	City, State, Zip Code:	Fitchburg, MA 01420					
	Phone #: <u>978-343-0300</u>		email: rba	ker@terratherm.com			
Q/	A/QC						
<u>x</u>	Characteristics of Interest						
	Good pre- and post-tre	eatment groundwater data	a	x Good pre- and	post-treatment	soil data	
	<u>x</u> Good temperature prof	file vs. time information		Flux assessmen	nt		
	Groundwater elevation	18		Geologic cross	-section		
	Hydraulic Conductivit	y information					

0560

General Site Information

			140 -1-1 (61)	-	(6)		
Impacted Z	o "		Width (ft):	Thick	iness (ft):		<u>X</u> Unkn
		as defined by documentation nod for determining size of in		one definition attack	nte)		
	Map attachmen	-	ipacieu zurie (See Suurce 2	one deminion anachmer	110)		
	map addonnen	•					
Monitor W	ells: Number of relevant i	nonitoring wells with ground	water data:				x None
		5		:	Post-treatment:		
	Number of wells rela	tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ossgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	ossgradient:	
Soil Borings	s: Number of relevant s	oil borings with pre-treatmen	t data: <u>10</u>				
		oil borings with post-treatmen					
	Number inside treatm			e treatment zone:			
		-					
Types of Co	ontaminants						
					ent Concentration per	Average Post-treatn	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Cher Groundwater (mg/L)	nical: Soil (mg/kg)	Che Groundwater (mg/L)	mical: Soil (m
	Trichloroethene	Hexane	Creosote	None None	None None	None None	None
•	Tetrachloroethene	Jet Fuel	x Arclor 1260 @6"	None	1,000 mg/kg	None	0.01 mg/l
	1,1-dichloroethene	Napthalene	x Arclor 1260 @12"	None	1 mg/kg	None	0.01 mg/l
	cis-1,2-dichloroethene	Benzene	x Arclor 1260 @18"	None	1 mg/kg	None	0.1 mg/k
	trans-1,2-dichloroethene	Tolune	x Arclor 1260 @24"	None	1 mg/kg	None	1 mg/kg
l.							
-	1,1-dichloroethane	Ethylbenzene		None	None	None	None
-	1,1-dichloroethane	Ethylbenzene m/p-xylene		None None	None	None	None None
		-					
Chemicals of Concern	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None None	None None	None None	None None
	1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane	m/p-xylene		None None None	None None None	None None None	None None None
	1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	m/p-xylene		None None None None	None None None	None None None None	None None None
	1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	m/p-xylene		None None None None	None None None None None	None None None None None	None None None None
	1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	m/p-xylene		None None None None None None			
	1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	m/p-xylene		None None None None None None None	None None None None None None None None	None None None None None None None	None None None None None None None
	1,2-dichloroethane 1,1,1-trichloroethane 1,1,2-trichloroethane 1,1,2,2-tetrachloroethane	m/p-xylene		None None None None None None None None	None None None None None None None None	None None None None None None None None	None None None None None None None None

x Impacted 2	Zone: Length (parallel to flo	ow direction)(ft.):		Width (ft):	Thick	ness (ft):		<u>x</u> Unkno
	Impacted zone	as defined by documentatio	n					
		hod for determining size of in	npac	ted zone (See source :	zone definition attachmer	nts)		
	Map attachmer	nt						
<u>x</u> Monitor W	Yells: Number of relevant	monitoring wells with ground	lwate					x None
	Number of wells role	ative to treatment zone:		Pre-treatmen	t:	Post-treatment:		
	Pre-treatment			Jpgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatmen			Ipgradient:	Downgradient:		ssgradient:	
x Soil Boring	s: Number of relevant s	oil borings with pre-treatmer	nt data	a: <u>9</u>				
	Number of relevant s	soil borings with post-treatme	nt da	ta: <u>9</u>				
	Number inside treatn	nent zone:		Number outsi	de treatment zone:			
x Types of C	ontaminants							
					Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Cher	
	Chlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (m
	Trichloroethene	Hexane		Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel	<u>x</u>	Arclor 1260 @6"	None	100 mg/kg	None	0.01 mg/k
	1,1-dichloroethene	Napthalene	x	Arclor 1260 @12"	None	1 mg/kg	None	0.01 mg/k
	cis-1,2-dichloroethene	Benzene	x	Arclor 1260 @18"	None	1 mg/kg	None	0.1 mg/kg
	trans-1,2-dichloroethene	Tolune	x	Arclor 1260 @24"	None	1 mg/kg	None	0.1 mg/kg
	1,1-dichloroethane	Ethylbenzene			None	None	None	None
	1,2-dichloroethane	m/p-xylene		 _	None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene	_		None	None	None	None
Concern	1,1,2-trichloroethane		_		None	None	None	None
	1,1,2,2-tetrachloroethane		_		None	None	None	None
	Vinyl Chloride	-			None	None	None	None
					None	None	None	None None
					None	None	None	None
					110110	110110	1,010	
					None	None	None	None
					None None	None	None	None None

x Impacted	Zone: Length (parallel to flo	ow direction)(ft.):		Width (ft):	Thick	ness (ft):		<u>x</u> Unkn
	= "	as defined by documentation	1	• • • •				
	Alternative met	hod for determining size of ir	npact	ed zone (See source z	zone definition attachmer	its)		
	Map attachmer	nt						
<u>x</u> Monitor V	Vells: Number of relevant	monitoring wells with ground	wate					x None
	Number of wells rela	ative to treatment zone:		Pre-treatment	t:	Post-treatment:		
	Pre-treatment			pgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatmen			pgradient:	Downgradient:		ssgradient:	
	i ost-tieautien			pgradient	Downgradient.		asyradient	
x Soil Boring	gs: Number of relevant s	oil borings with pre-treatmen	it data	a: <u>17 (111 s</u>	samples)			
	Number of relevant s	soil borings with post-treatme	nt da	ta: <u>14 (101 s</u>	samples)	pre- and 4 post-		
	Number inside treatn	nent zone: 31		Number outsid	de treatment zone: treatr	nent samples were		
y Typon of (Contaminants							
x Types of 0	ontaminants							
					Chen	ent Concentration per nical:	Average Post-treatm Chen	
	Chlorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (m
	Trichloroethene	Hexane	-	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel	<u>x</u>	Arclor 1260 @2'	None	1,000 mg/kg	None	0.01 mg/k
	1,1-dichloroethene	Napthalene	x	Arclor 1260 @4'	None	100 mg/kg	None	0.01 mg/k
	cis-1,2-dichloroethene	Benzene	x	Arclor 1260 @6'	None	100 mg/kg	None	0.01 mg/k
	trans-1,2-dichloroethene	Tolune	x	Arclor 1260 @8'	None	10 mg/kg	None	0.01 mg/k
	1,1-dichloroethane	Ethylbenzene	x	Arclor 1260 @ 10'	None	1 mg/kg	None	0.01 mg/k
	1,2-dichloroethane	m/p-xylene	x	Arclor 1260 @ 12'	None	5 mg/kg	None	0.01 mg/k
Chemicals of	1,1,1-trichloroethane 1,1,2-trichloroethane	o-xylene	x x	Arclor 1260 @14' Arclor 1260 @16'	None	1 mg/kg	None	0.1 mg/k
Concern	1,1,2-tricnioroethane		×	Arcior 1200 @ 16	None	0.1 mg/kg None	None	0.01 mg/k None
				-				None
			_		None	None	None	None
	Vinyl Chloride						None	
	Vinyl Chloride				None		None	
	Vinyl Chloride				None	None	None None	None
	Vinyl Chloride				None None	None None	None	None None
	Vinyl Chloride				None	None		None

Facility ID#: Hydrogeologic Conceptual Model 0560 Geology: Zone **Unconsolidated Sediments** Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: _ Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl _ Unknown 404 Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): 40 high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: ___ Slug Test Field data Laboratory X low Unknown 3 x 10E-3 md horiz. air permeability pre-treatment high 50 md horiz. air permeability post-treatment

Comments:

Attachments:

Transmissivity (ft2/day):

Air permeability data from Vinegar et al. 1997, HazWaste World / Superfund XVIII, Washington, DC, p.

_ Slug Test

Cape Girardeau, Missouri. U.S. ENVIRONMENTAL PROTECTION AGENCY, Office of Solid Waste and

____ Laboratory

Field data

Unknown

Emergency Response, Technology Innovation Office. pp. 282-288. also: France-Isetts, P. 1998. "In Situ Thermal Blankets and Wells for PCB Removal in Tight Clay Soils," Tech Trends, EPA Region 7. (February). Available at:

http://clu-in.org/products/newsltrs/TTREND/tt0298.htm

Measured using:

low

high

The	rmal Treatment - Design								Fa	cility ID#:	056	<u>0</u>
<u>x</u>	Thermal treatment:	_	onductive	e <u>The</u> Resistance	ermal b	lanket 1						
						6 phase		AC	power		OC power	
			ther (des	_ Steam		Steam +	air	Stea	nm + O2			
<u>x</u>	Type of Test: <u>x</u>	Pilot tes		Ful	ll-scale	System						
x	Geology of Treatment Zon	e:				ogeneous and	permeat	ole uncons	olidated se	diments		
			<u>x</u>	Relativel	ly hom	ogeneous and	imperme	eable unco	nsolidated	sediments	S	
				_ Largely	permea	able sediments	with inte	er-bedded l	enses of lo	wer perm	eability	material
				_ Largely i	mperm	eable sedimer	nts with i	nter-bedde	d layers of	higher pe	ermeabili	ty material
				_ Compete	ent, bu	fractured bedi	rock (i.e.	crystalline	rock)			
				_ Weather	ed bec	lrock, limestone	e, sands	tone				
<u>x</u>	Treatment Targe Zone:	s	aturated	only	<u>x</u>	Vadose only		Bot	h (Saturated	l and Vado	se zones)	
	_ Start of Thermal Test:	3/13/199	97			D	uration:	32 days				
<u>x</u>	Hydraulic Control	<u>x</u> Y	es	No								
<u>x</u>	Treatment Cell Design:											
	Size of target zone (ft2):				<u>160</u>				_ Unknow	n (<u>8</u> x	<u>20</u> ft)
	Thickness of target zone (f	•			2				_ Unknow			
	Depth to top of target zone				0				_ Unknow			
	Thickness of target zone b		er table	(ft):	0				_ Unknow			
	Number of energy delivery				1				_ Unknow			
	Number of extraction point	s:			2				_ Unknow	1		
<u>x</u>	Temperature Profile:											
	Initial formation temperatur	re (deg C	;):			<u>23.8</u>			_	Unknow	wn	
	Maximum representative for	ormation	tempera	ture (deg	C):	<u>315</u>				Unknov	vn	
	Time to reach maximum re	presenta	tive tem	perature (days):	<u>30</u>				Unknow	wn	
	Duration of treatment at re	presentat	tive temp	oerature (d	days):	1				Unknov	wn	
	Formation temperature imr	mediately	nost-tre	atment:			Date	<u>e</u>		Tempera	ture (deg	<u>1 C)</u>
	Formation temperature pos				nt 1:							
	Duration of post-treatment			_					_			
<u>x</u>	Mass of contaminant remo	ved:										
	Via	liquid pur	mping:					lb	<u>x</u>	kg	<u>x</u>	Unknow
	In va	apor strea	am:					lb	<u>x</u>	kg	<u>x</u>	Unknow
	Tota	al:						lb	<u>x</u>	kg	<u>x</u>	Unknow
	Comments:											
	Attachments:											
												

The	mal Treatment - Design			Fa	acility ID#:	0560
<u>x</u>	_	ductive Thermal blankets trical Resistance	: 2			
	Stean	3 phase	6 phase	AC power	DC pc	ower
			_ Steam + air	Steam + O2		
<u>x</u>	Type of Test: <u>x</u> Pilot test Geology of Treatment Zone:	Full-scale System Relatively homogene Relatively homogene Largely permeable se Largely impermeable Competent, but fractu Weathered bedrock, l	ous and permeable u ous and impermeable ediments with inter-be sediments with inter- ured bedrock (i.e. crys	e unconsolidated edded lenses of l -bedded layers of stalline rock)	I sediments ower permeabi	-
<u>x</u>	Treatment Targe Zone: Satur	urated only <u>x</u> Vado	ose only Duration: 22	Both (Saturate	d and Vadose zo	nes)
<u>x</u>	Hydraulic Control <u>x</u> Yes	No				
X	Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (ft): Depth to top of target zone (ft bgs): Thickness of target zone below water to the control of target zone (ft2):	$\begin{array}{c} 310 \\ \underline{2} \\ \underline{0} \\ \text{table (ft):} \\ \underline{0} \\ \underline{2} \\ \underline{2} \end{array}$		Unknow Unknow Unknow Unknow Unknow Unknow	n n n	x <u>20</u> ft)
X	Temperature Profile: Initial formation temperature (deg C): Maximum representative formation tem Time to reach maximum representative Duration of treatment at representative	e temperature (days):	29.4 315 22 1	- - -	Unknown Unknown Unknown Unknown	
	Formation temperature immediately po Formation temperature post-treatment Duration of post-treatment monitoring (monitoring event 1:	<u>Date</u>		Temperature	(deg C)
X	Mass of contaminant removed: Via liquid pumpii In vapor stream: Total:		_	lb <u>x</u> lb <u>x</u> lb <u>x</u>	kg kg kg	Unknow Unknow Unknow
	Comments:					
	Attachments:					

The	rmal Treatment - Design					Facility ID#:	<u>0560</u>
<u>x</u>	Thermal treatment:	<u>x</u> Conductive <u>The</u>	ermal Wells				
		Electrical Resistance					
		3 phase		_ 6 phase	AC power	DO	power
		Steam Steam		_ Steam + air	Steam +	O2	
~	Type of Test: <u>x</u>	Other (describe) Pilot test Ful	ll-scale Syster	n			
<u>x</u>	Geology of Treatment Zone		-	ous and permea	ble unconsolida	ted sediments	
-			-	eous and imperm			
			-	•		es of lower perme	ability material
		Largely i	mpermeable	e sediments with	inter-bedded lay	ers of higher per	meability material
		Compete	ent, but fract	ured bedrock (i.e	. crystalline rock	<)	
		Weather	ed bedrock,	limestone, sands	stone		
<u>x</u>	Treatment Targe Zone:	Saturated only	<u>x</u> Vad	lose only	Both (Sa	turated and Vadose	zones)
	Start of Thermal Test:	<u>4/21/1997</u>		Duration:	42 days		
<u>x</u>	Hydraulic Control	<u>x</u> YesNo					
<u>x</u>	Treatment Cell Design:						
	Size of target zone (ft2):		<u>144</u>		Ur	nknown (_ x ft)
	Thickness of target zone (ft	t):	<u>12</u>		Ur	nknown	
	Depth to top of target zone	(ft bgs):	<u>0</u>		Ur	nknown	
	Thickness of target zone be	elow water table (ft):	<u>0</u>		Ur	nknown	
	Number of energy delivery	points:	<u>12</u>		Ur	nknown	
	Number of extraction points	S:	<u>6</u>		Ur	nknown	
<u>x</u>	Temperature Profile:						
	Initial formation temperature	e (deg C):		<u>79</u>		Unknow	ı
	Maximum representative fo	· · ·		<u>325</u>		Unknow	
	Time to reach maximum re			<u>45</u>		Unknow	
	Duration of treatment at rep	presentative temperature (c	lays):	<u>6</u>		Unknow	n
				<u>Dat</u>	<u>e</u>	Temperatu	ire (deg C)
	Formation temperature imn						
	Formation temperature pos	_	nt 1:			-	
	Duration of post-treatment	monitoring (days):					
<u>x</u>	Mass of contaminant remov						
		iquid pumping:	<u>40</u>		lb	<u>x</u> kg	Unknow
		apor stream:	4(10 ^		lb	<u>x</u> kg	Unknow
	Tota	l:	<u>40</u>	!	lb	<u>X</u> kg	Unknow
	Comments:						
	<u>Mass</u> in t	hermal well application o	nly	Thermal well	s on a 5ft cente	er spacing	
	Attachments:						
		-					

Cos	st and Performance	Э					Facility ID#:	<u>0560</u>
<u>x</u>	Performance							
_	Remediation Go	al:						
			_ In Groundwater:					
			-					
		<u>x</u>	In Soil:					
		_			< 2 ppm P(CB: Arclor 126	<u>0</u>	
	Was the Remed	iatio	n Goal Achieved:					
		_	_ In Groundwater					
			Comment:					
			-					
		<u>x</u>	In Soil					
			Comment:					
			<u>-</u>	<u>Yes</u>				
	General comme	nts o	on the thermal applic	cation:				
	Goals of al demos:	13						1.
	Clean soils	with	nin arrays to achieve	e <2ppm total PCBs; 2.	Show stack discha	arges could me	eet compliance std	s with the state and
				ed dibenzodioxins/diben greater than 99.9999%	zofurans (PCDDs/	<u>/PCDFs); and</u>	3. obtain a system	destruction and
	Lessons Learne	d						
	-							
								
	_							
_	_ Energy							/ .3
	Total Energy Us				kWhr	kWhr/		
			al energy applied to	treatment zone:			kWhr/m ³	kWhr/yd ³
		Oth	er energy:	_			kWhr/m ³	kWhr/yd ³
			Please	e note other energy:				
	Cost							
	Total Project Co	st.						
			nsultant Cost:					
			rmal Vendor Cost:					
			ergy Cost:	-		m ³	yd³	
			er Cost 1:			_''' ·	yu	
			er Cost 2:	-				
			er Cost 3:					
	Please not	e oth	ner cost:	Other Cost 1:				
			-	Other Cost 2:				

Facility ID#: 0562 File Analyzed By: PD ____ Date: 11/3/2006 ____Steam Type of treatment: Conductive <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents _ Petroleum Hydrocarbons Wood Treating Other: Treatment Status: _Active Post ___ Full Scale System Type of Test: _Pilot Test Start of Test: End of Test: _____ Duration: 120 d Type of Site: ___ DoD Non-DOD Facility Name: Confidential St. Louis, MO Address: City, State, Zip Code: St. Louis, MO OU# or Site #: Primary point of contact: David Sarr Organization: Address: City, State, Zip Code: Phone #: <u>703-709-6500</u> email: david.sarr@wspgroup.com Other contacts or vendors who worked on site _ None Point of contact: Dacre Bush Type: Vendor, Consultant _____ Vendor, Technical Applications __Other Organization: McMillian-McGee Address: City, State, Zip Code: Phone #: 805-295-9071 email: dacre.bush@mcmillian-mcgee.com QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

General Site Information

___ Hydraulic Conductivity information

General Site As	ssessment Data					Facility II	D#: <u>0562</u>
Impacted	5 ".		Width (ft):	Thick	ness (ft):		Unknown
	 -	as defined by documentation					
		=	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor V	Wells: Number of relevant n	nonitoring wells with groundy			Doot to other out		None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				· · · · g · · · · · ·			
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
		il borings with post-treatmen					
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Types of 0	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ante:						
Comme							
	<u> </u>						
Attachmer	nts:						

rogeologic Conceptua	al Model			Facility ID#: 056						
Geology:	Zone	<u>Unconsolidated Sediments</u>								
	Vadose Zone:	Relatively homogeneous and	permeable unconsolidated sedir	nents						
		x Relatively homogeneous and	mpermeable unconsolidated se	diments						
		Largely permeable sediments with inter-bedded lenses of lower permeability material								
		Largely impermeable sediments with inter-bedded layers of higher permeability material								
		Competent, but fractured bedrock (i.e. crystalline rock)								
		Weathered bedrock, limestone	, sandstone							
	Saturated Zone:	Relatively homogeneous and	permeable unconsolidated sedir	nents						
		x Relatively homogeneous and	mpermeable unconsolidated se	diments						
		Largely permeable sediments	with inter-bedded lenses of lower	er permeability material						
		Largely impermeable sedimen	ts with inter-bedded layers of high	gher permeability material						
		Competent, but fractured bedr	ock (i.e. crystalline rock)							
		Weathered bedrock, limestone	, sandstone							
_ Ground surface elev	vation based on wells in c	adjacent to treatment zone:	ft amsl	Unknown						
_ Aquifer Characteris	tics:									
Is more than 1 aquit	fer present?	No Yes (number):	Unki	nown (assume single aquifer)						
		Aquifer 1 Aquife	r 2 Aquifer 3							
Depth to water:	low value (ft bgs):									
	high value (ft bgs):									
	Unknown:									
_ Flow direction										
_	: gradient (feet/foot):			Unknown						
_	, ,			Unknown Unknown						
_ Horizontal hydraulic	, ,	ısing:Slug Test	Laboratory							
_ Horizontal hydraulic Vertical hydraulic gr	radient (feet/foot):	ısing: Slug Test _	Laboratory	Unknown						
_ Horizontal hydraulic Vertical hydraulic gr	radient (feet/foot): Measured	Ising: Slug Test _	Laboratory	Unknown Field data						
_ Horizontal hydraulic Vertical hydraulic gr	radient (feet/foot): Measured low high		Laboratory	Unknown Field data						
_ Horizontal hydraulic Vertical hydraulic gr _ K range (ft/day)	radient (feet/foot): Measured low high			Unknown _Field data Unknown						

Attachments:

The	ermal Treatment - Design								Facility ID#:	0562
<u>x</u>	Thermal treatment:		Conductive							
		<u>x</u>	Electrical R	Resistance						
				3 phase		6 phase		AC power	DC	power
			Steam			g		1		
				_ Steam		Steam + air	—;	Steam + C	02	
	Town of Tools		Other (desc		1.6.					
	Type of Test:	_ Pilot t		· ·	scale System		hla			
<u>x</u>	Geology of Treatment Zon	e:			_	ous and permea				
			<u>X</u>	-	-	ous and imperm			of lower perme	ahility material
									•	meability material
						red bedrock (i.e				materia.
				-		imestone, sands	-	,		
	_ Treatment Targe Zone:		Saturated	='	Vado			Both (Satı	arated and Vadose	e zones)
<u>s</u>	Start of Thermal Test:					Duration:		(,
	_ Hydraulic Control		Yes	No	-					
	_ Treatment Cell Design:									
	Size of target zone (ft2):						· <u>-</u>	Unk	nown (_ x ft)
	Thickness of target zone (f	t):					_	Unk	nown	
	Depth to top of target zone	(ft bgs	s):					Unk	nown	
	Thickness of target zone b	elow w	ater table (ft):			-	Unk	nown	
	Number of energy delivery	points	:				-	Unk	nown	
	Number of extraction point	s:			-		· <u>-</u>	Unk	known	
v	Tomporatura Profile:									
<u>X</u>	Temperature Profile: Initial formation temperature	re (dea	C).						Unknow	n
	Maximum representative for			ture (dea C).	<u>95</u>		_	Unknow	
	Time to reach maximum re		•			20			Unknow	
	Duration of treatment at re	-	-		-				Unknow	
	,			(11	<i>y</i> -,					
						Dat	te_		Temperatu	ire (deg C)
	Formation temperature imr	mediate	ely post-tre	atment:						
	Formation temperature pos	st-treat	ment monit	toring even	t 1:					
	Duration of post-treatment	monito	ring (days)):						
	Mana of soutominant roma									
<u>x</u>	Mass of contaminant remo		umning				1	L	1	Halmon
		apor st	oumping:				1		kg	Unknow
	Tota		ream.		69000	<u> </u>	l	b	kg	Unknow
	100	аі.			09000	<u>2</u>	<u>x</u> 1	ь	kg	Clikilow
	Comments:									
	24.6									
	24 ft spa	cing								
	Attachments:									
			<u> </u>	-		·	·			

Cos	at and Performance			Facility ID:	#: <u>0562</u>
	_ Performance				
	Remediation Goal:				
	In Groundwater:				
	in Groundwater.				
	In Soil:				
	III 30II.				
	Was the Remediation Goal Achieved:				
	In Groundwater				
	Comment:				
	In Soil				
	Comment:				
	General comments on the thermal appli				
	General comments on the thermal appli	cation.			
	Cool, 200/ reduction				
	Goal: 99% reduction				
	Lessons Learned				
	,				
<u>x</u>	Energy			0	
	Total Energy Used: 203.5	_	kWhr	kWhr/m ³ <u>x</u>	kWhr/yd ³
	Total energy applied to	treatment zone:		kWhr/m ³	kWhr/yd ³
	Other energy:	_		kWhr/m ³	kWhr/yd ³
	Pleas	e note other energy:	-		
	_ Cost				
	Total Project Cost:				
	Consultant Cost:				
	Thermal Vendor Cost:				
	Energy Cost:			m ³ yd ³	
	Other Cost 1:				
	Other Cost 1:	-			
	Other Cost 3:				
	Other Cost 3:	Other Cost 1:			
	i lease note other cost.				
	•	Other Cost 2:			
		Other Cost 3:			

File Analyzed By: PD ____ Date: 10/13/2006 ____Steam Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating _Other: Treatment Status: Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: 6/24/2005 End of Test: 10/18/2005 Duration: 117 d Type of Site: Non-DOD __ DoD Facility Name: Operating Industrial Manufacturing Facility, Confidential Location, Missouri City, State, Zip Code: Missouri OU# or Site #: Primary point of contact: Larry Williams Organization: SECOR Address: 400 Bruns Lane City, State, Zip Code: Springfield, IL 62702 Phone #: 217-698-7247 ext 25 email: lwilliams@SECOR.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0564

General Site Information

___ Hydraulic Conductivity information

<u>x</u> Impacted	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u>	Unknown
	Impacted zone a	as defined by documentation	ı					
	Alternative meth	od for determining size of im	pacted zone (See source zo	ne definition attachmer	nts)			
	Map attachment							
x Monitor V	Vells: Number of relevant n	nonitoring wells with grounds	water data:					None
			Pre-treatment:	1	Post-treatment:	<u>1</u>		
	Number of wells relat	ive to treatment zone:						
	Pre-treatment	In:	Upgradient:	Downgradient:	Cre	ossgradient:		
	Post-treatment	In:	Upgradient:	Downgradient:	Cre	ossgradient:		
x Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data: <u>13</u>					
	Number of relevant so	il borings with post-treatmer						
	Number inside treatme			treatment zone:				
			_					
x Types of C	Contaminants							
				Average Pre-treatme	ent Concentration per	Average Post-treatm	nent Co mical:	ncentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	10 mg/L	500 mg/kg	0.01 mg/L		05 mg/kg
	Tetrachloroethene	Jet Fuel		None	None	None		None
	1,1-dichloroethene	Napthalene		None	None	None		None
	cis-1,2-dichloroethene	Benzene		None	None	None		None
	trans-1,2-dichloroethene	Tolune		None	None	None		None
	1,1-dichloroethane	Ethylbenzene		None	None	None	1	None
	1,2-dichloroethane	m/p-xylene		None	None	None		None
	1,1,1-trichloroethane	o-xylene		None	None	None		None
Chemicals of	1,1,2-trichloroethane	o-xylene		None	None	None		None
Concern	1,1,2-tremorbethane							
	Vinyl Chloride			None	None	None		None
	vinyi Chioride	-	-	None	None	None		None
				None	None	None		None
				None	None	None		None
				None	None	None		None
				None	None	None	-	None
				None	None	None		None
				None	None	None		None
Comme	ents:							
22								
Attachmer	nte:							
Audonner	110.							

0564

General Site Assessment Data

<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sediments	
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sedi	iments
			Relatively homogeneous and impermeable unconsolidated so	ediments
			Largely permeable sediments with inter-bedded lenses of low	ver permeability material
			 <u>x</u> Largely impermeable sediments with inter-bedded layers of h 	igher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sedi	iments
		Catalatea Eolie.	Relatively homogeneous and impermeable unconsolidated so	
			Largely permeable sediments with inter-bedded lenses of low	
			 Largely impermeable sediments with inter-bedded layers of h 	
			Competent, but fractured bedrock (i.e. crystalline rock)	ignor pormodolity material
			Weathered bedrock, limestone, sandstone	
			weathered bedrock, illnestone, sandstone	
<u>x</u>	Ground surface eleva	ation based on wells in o	r adjacent to treatment zone: ft amsl	<u>x</u> Unknown
<u>x</u>	Aquifer Characteristic	es:		
	Is more than 1 aquife	r present?	No Yes (number): <u>x</u> Unl	known (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3	
	Depth to water:	low value (ft bgs):	6	
	·	high value (ft bgs):		
		Unknown:		
	Flow direction			
<u>x</u>	Horizontal hydraulic g	radient (feet/foot)		<u>x</u> Unknown
^	Vertical hydraulic grad	,		<u>x</u> Unknown
	vertical flydraulic gra	aicht (icct/ioot).		<u>A</u> Chrhown
v	K range (ft/day)	Maggurad	using: Slug Test Laboratory	Field data
<u>X</u>	it range (iliday)		using Sing rest Laboratory	
		low		<u>x</u> Unknown
	Too a contract the MONE	high	using: Slug Test Laboratory	F: 11.1.
	Transmissivity (ft2/da			Field data
		low		<u>x</u> Unknown
		high		
	Comments:			
	The	geology is a residual	clay with variable limestone and chert floaters	
	Attachments:			

0564

Hydrogeologic Conceptual Model

	_ Thermal treatment:		Conductiv	ve							
		<u>x</u>	Electrical	Resistance _							
			_	3 phase	6 p	hase	AC I	oower	DC	power	
		_	_ Steam	<u> </u>	Gr.		C				
			Other (de	Steam	Ste	am + air	Stea	m + O2			
<u>x</u>	Type of Test:	e Pilo	_ Other (de ot test	Full-sca	le System						
<u>^</u>	Geology of Treatment 2	_		Relatively ho	-	and permeal	ole unconso	lidated sed	iments		
^	Coology of Trodunoin 2	20110.		Relatively ho							
				Largely perm	-	-				ability n	naterial
			<u>x</u>	Largely impe					·	•	
			-	Competent, I					3 - 1 -		,
				Weathered b			-	,			
<u>x</u>	Treatment Targe Zone:		Saturate		Vadose o			(Saturated a	nd Vadose	zones)	
<u>x</u>	Start of Thermal Test:		 4/2006	, _		Duration:					
_	Hydraulic Control		Yes	No							
<u>X</u>	Treatment Cell Design:										
	Size of target zone (ft2)				<u>90</u>			_ Unknown	(_ x	ft)
	Thickness of target zon	` '		<u>18</u>				_ Unknown			
	Depth to top of target z	, ,	,	4				_ Unknown			
	Thickness of target zon				="			Unknown			
	Number of energy deliv		ts:	18	='			_ Unknown			
	Number of extraction po	oints:		3:	<u>l</u>			_ Unknown			
<u>x</u>	Temperature Profile:										
	Initial formation temper	ature (de	eg C):		<u>24</u>				Unknown		
	Maximum representativ	e format	tion temper	ature (deg C):	100	<u>)</u>			Unknown		
	Time to reach maximur	n represe	entative ter	nperature (days): <u>53</u>				Unknown		
	Duration of treatment a	t represe	entative ten	nperature (days)): <u>64</u>				_ Unknown		
						<u>Date</u>	Э	Т	emperatu	re (dea	C)
	Formation temperature	immedia	ately post-tr	reatment:							
	Formation temperature	post-trea	atment mor	nitoring event 1:							
	Duration of post-treatm	ent moni	itoring (day	s):							
<u>x</u>	Mass of contaminant re	emoved:									
_	,	√ia liquid	l pumping:				lb		_ kg	<u>x</u>	Unknov
		n vapor					lb		_ kg	<u>x</u>	Unknov
		Total:					lb		_ kg	<u>x</u>	Unknov
	Comments:										
			n points w was used.	ere 18 electrod	de/vapor red	overy wells	and 13 ad	lditional va	por recov	ery we	ells, of
	Attachments:										

Cos	t and Performance	;	Facility ID#: 0564
<u>x</u>	Performance		
_	Remediation Go	al:	
		In Groundwater: -	
		III Groundwater.	
		x In Soil:	
		_	000/ (1) 11 1/ 1 705 1 1/ 0.4 1/ 4.000/
		<u>At a</u>	90% upper confidence limit, reduce TCE in soil to 0.4mg/kg. A 99% removal was needed.
	Was the Remedi	ation Goal Achieved:	
		Comment:	
		Comment.	
			
		x In Soil	
		Comment:	
		<u>ye</u>	s, had a percent removal of 99.96%
	General commer	nts on the thermal applica	ttion:
	Took a data	a set on the dissolved or	panic carbon (DOC) in groundwater and found a 41 times higher amount of DOC in post-
	treatment s	samples. Which is import	ant because it further substantiates that ERH creates favorable conditions for enhanced
	<u>biodegrada</u>	tion by increasing the DC	OC content in groundwater making it more bio-available.
	Lessons Learned	d	
			
v	Energy		
<u>x</u>		- d. 007446	1337 JAMI(3 JAMI(13
	Total Energy Use		-
		Total energy applied to t	
		Other energy:	kWhr/m ³ kWhr/yd ³
		Please	note other energy:
	0 1		
_	_ Cost		
	Total Project Cos		
		Consultant Cost:	
		Thermal Vendor Cost:	
		Energy Cost:	m³ yd³
		Other Cost 1:	
		Other Cost 2:	
	_	Other Cost 3:	
		e other cost:	Other Cost 1:
			Other Cost 2:
		_	

<u>x</u>	File Analyzed By: JT	<u>x</u> PD			Date:	10/18/2006
	Type of treatment:	Conductive	Steam	<u>x</u> ERHOthe	er:	
	Type of Contaminant:	Chlorinated Sol	vents <u>x</u>	Petroleum Hydrocarbons	Pesticides	
		Wood Treating		Other:		
	Treatment Status:	Active	<u>x</u> Post			
	Type of Test:	Pilot Test	Full Scal	le System		
	Start of Test:	7/11/2003	Enc	1 of Test: <u>11/30/2003</u>	Duration: 142 d	
	Type of Site:	<u>x</u> Non-DOD	DoD			
<u>x</u>	Facility Name: George's C	<u>Conoco</u>				
	Address:					-
	City, State, Zip Code:	Ronan, MT				
	OU# or Site #:					_
<u>X</u>	Primary point of contact:	Ken Manchester				
	Organization: MSE Tech	nnology Applications				
	Address: 200 Technology	Way				
	City, State, Zip Code:	Butte, MT				
	Phone #: 406-494-7397		email: <u>ke</u>	n.manchester@mse-ta.com		
<u>x</u>	Other contacts or vendors wh	ho worked on site		None		
	Point of contact: <u>Jeffr</u>	rey A. Kuhn				
	Type:Vendor, C	onsultant	Vendor, Techn	ical Applications	Other	
	Organization: Montana I	Dept. of Environmental (Quality			
	Address: PO Box 20090					
	City, State, Zip Code:	Helena, MT 59620-09	<u>901</u>			
	Phone #: 406-841-5000		email: <u>jkı</u>	ıhn@state.mt.us		
Q	A/QC					
	_ Characteristics of Interest					
	Good pre- and post-tre	atment groundwater dat	ta	Good pre- and post-tre	atment soil data	
	Good temperature prof	file vs. time information		Flux assessment		
	Groundwater elevation			Geologic cross-section		
	Hydraulic Conductivit	y information				

0565

General Site Information

<u>x</u> Impacted	Impacted zone a	w direction)(ft.): below Width (ft): Thickness (ft): as defined by documentation od for determining size of impacted zone (See source zone definition attachments)									
<u>x</u> Monitor	Wells: Number of relevant n	nitoring wells with groundwater data: Pre-treatment: 3 Post-treatment:									
	Number of wells related	tive to treatment zone:	re to treatment zone:								
	Pre-treatment	In:	ssgradient:								
	Post-treatment		Upgradient:	Downgradient: Downgradient:		ssgradient:					
x Soil Borin	ngs: Number of relevant so	oil borings with pre-treatment	data: <u>5</u>								
	Number of relevant so	oil borings with post-treatmen	t data:								
	Number inside treatm	ent zone:	Number outsid	le treatment zone:							
x Types of	Contaminants										
				Average Pre-treatme		Average Post-treatm Cher	ent Concentration per				
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	Trichloroethene	Hexane	Creosote	None	None	None	None				
	Tetrachloroethene	Jet Fuel		None	None	None	None				
	1,1-dichloroethene	Napthalene		None	None	None	None				
	cis-1,2-dichloroethene	x Benzene		10 mg/L	None	None	None				
	trans-1,2-dichloroethene	<u>x</u> Tolune		None	None	None	None				
	1,1-dichloroethane	<u>x</u> Ethylbenzene		None	None	None	None				
	1,2-dichloroethane	x m/p-xylene		None	None	None	None				
	1,1,1-trichloroethane	x o-xylene		None	None	None	None				
Chemicals of Concern	1,1,2-trichloroethane	x MTBE		10 mg/L	None	None	None				
Concern	1,1,2,2-tetrachloroethane	x TPH		100 mg/L	None	0.001 mg/L	None				
	Vinyl Chloride			None	None	None	None				
	vinyi cinonae			None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
			<u> </u>	None	None	rvone	rone				
Commo	ents:										
	released		4,000 to 6,000 ga	llons of premium gasol	<u>ine</u>	All chemicals below	w detection limit in				
	TOTOGOGG	soil exc	ept for 1 xylene hit and th	ne highest TPH Concer	ntration at 35 ug/L	Orientidate Delo	actodion inflit in				
Attachme	ents:										

0565

General Site Assessment Data

<u>x</u>	Geology:	Zone	Unconsolidated Sediments								
	Coolegy.	Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated sediments								
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			x Largely impermeable sediments with inter-bedded layers of higher permeability material								
	Competent, but fractured bedrock (i.e. crystalline rock)										
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated sediments								
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			 <u>x</u> Largely impermeable sediments with inter-bedded layers of higher permeability material 								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
	Ground surface eleva	tion based on wells in o	or adjacent to treatment zone: ft amsl Unknown								
<u>x</u>	Aquifer Characteristic	s:									
	Is more than 1 aquifer	present?	No	Unknown (assume single aquifer)							
			Aquifer 1 Aquifer 2 Aquifer 3								
	Depth to water:	low value (ft bgs):	<u> </u>								
		high value (ft bgs):	<u></u>								
		Unknown:									
	Flow direction										
	_ Horizontal hydraulic g	radient (feet/foot):	Unknown								
	Vertical hydraulic grad	dient (feet/foot):	Unknown								
<u>X</u>	K range (ft/day)	Measured	<u> </u>								
		low	<u>0.028</u> Unknown								
		high									
	Transmissivity (ft2/day	,	· — · — · —								
		low	Unknown								
		high									
	Occupant										
	Comments: K= 1	10e-6 cm/s_									
			in the Areatanant								
	16 f	was deptn-to-water i	in the treatment zone.	_							

0565

Hydrogeologic Conceptual Model

The	mal Treatment - Design								Facility ID#:	<u>0565</u>
<u>x</u>	Thermal treatment:		_ Conduc	tive						
		<u>x</u>	Electric	al Resistance						
			_	3 phase	_	6 phase		_ AC power	DC	power
			_ Steam	Steam		Steam + air	•	Steam + O	2	
			Other (c	describe)	_			_ 5.64	-	
<u>x</u>	Type of Test:	Pilot			ıll-scale Syst	em				
<u>x</u>	Geology of Treatment Zor			_	•	neous and per	meable ur	nconsolidate	d sediments	
			_	Relative	ely homoger	neous and imp	permeable	unconsolida	ated sediments	
			_	Largely	permeable	sediments wit	th inter-bed	dded lenses	of lower perme	ability material
			<u>x</u>	Largely	impermeab	le sediments	with inter-b	edded laye	rs of higher peri	meability material
			_	Compet	tent, but fra	ctured bedroc	k (i.e. crys	talline rock)		
			_	Weathe	red bedrock	k, limestone, s	andstone			
<u>x</u>	Treatment Targe Zone:		Saturat	ted only	Va	dose only	<u>x</u>	Both (Satu	rated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	7/11/	/2003			Dura	ation: <u>140</u>	d		
	_ Hydraulic Control		Yes	No	O					
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>6450</u>			Unk	nown (61 x <u>78</u> ft)
	Thickness of target zone (ft):			<u>10</u>			Unk	nown	
	Depth to top of target zon	e (ft bg	s):		<u>15</u>			Unk	nown	
	Thickness of target zone I	oelow v	vater tab	le (ft):	9			Unki	nown	
	Number of energy delivery	y points	3:		<u>12</u>			Unki	nown	
	Number of extraction poin	ts:			<u>6</u>			Unk	nown	
<u>x</u>	Temperature Profile:									
_	Initial formation temperatu	ıre (deç	g C):			<u>20</u>			Unknow	1
	Maximum representative	ormatio	on tempe	erature (deg	C):				Unknow	n
	Time to reach maximum r	eprese	ntative te	emperature ((days):				Unknow	ı
	Duration of treatment at re	epreser	ntative te	emperature (days):				Unknown	1
							Date		Temperatu	re (deg C)
	Formation temperature im	mediat	ely post-	-treatment:						
	Formation temperature po	st-trea	tment m	onitoring eve	ent 1:				-	
	Duration of post-treatmen	t monit	oring (da	ays):						
<u>x</u>	Mass of contaminant remo	oved:								
_			pumping	: _				_ lb	kg	Unknown
	In v	apor s	tream:	_				_ lb	kg	Unknown
	Tot	•		_	15	74		_ lb	<u>x</u> kg	Unknown
	Comments:									
		cing of	f 27.6 ft	and a SW	/NE spacin	g of 24.0 ft		Treate	d are - 2771 y	d3 with effective
	treatme	nt of 10	6 ft thick	<u> </u>						
	Attachments:									

Cost and Performance Facility ID#: 0565 Performance Remediation Goal: In Groundwater: MTBE - 30 ppb; Benzene-5 ppb; Toluene - 1000 ppb; TPH (RBSL) - 1000 ug/L In Soil: Was the Remediation Goal Achieved: x In Groundwater Comment: Yes, MTBE, benzene, toluene, ethylbenzene, were non-detect and xylene was below the MCL __ In Soil Comment: General comments on the thermal application: \$130/ cubic yard of effectively treated soil Lessons Learned Energy kWhr _ kWhr/yd³ Total Energy Used: 514120 ____ kWhr/m³ __ Total energy applied to treatment zone: kWhr/yd³ __ Other energy: kWhr/m³ _ kWhr/yd³ Please note other energy: Cost Total Project Cost: 360800 ____ Consultant Cost: __ Thermal Vendor Cost: x Energy Cost: <u>24404</u> ____ Other Cost 1: ____ Other Cost 2:

____ Other Cost 3:
Please note other cost:

Other Cost 1:
Other Cost 2:
Other Cost 3:

PD ____ File Analyzed By: Date: 10/15/2007 ____Steam ____Other: Type of treatment: _Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons __ Wood Treating ___ Other: Treatment Status: ____ Post ____ Active ___ Full Scale System Type of Test: ____ Pilot Test Start of Test: 11/4/2006 End of Test: 1/26/2007 Duration: 82 days Type of Site: ____Non-DOD __ DoD Facility Name: Eastern Montana Address: City, State, Zip Code: OU# or Site #: Primary point of contact: Galen Davis Organization: Kennedy Jenks Consultants Address: City, State, Zip Code: Phone #: <u>253-874-0556</u> email: galendavis@kennedyjenks.com Other contacts or vendors who worked on site _ None Point of contact: David Fleming ____ Vendor, Consultant Type: _____ Vendor, Technical Applications ____ Other Organization: Address: _ City, State, Zip Code: Phone #: email: ___ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0568

General Site Information

_____ Hydraulic Conductivity information

General S	ite Asses	sment Data					Facility II	D#: <u>0568</u>
Impa	acted Zor	5 "		Width (ft):	Thick	ness (ft):		Unknown
		 -	s defined by documentation					
			od for determining size of im	pacted zone (See source zo	ne definition attachmer	nts)		
		Map attachment						
Moi	nitor Well	s: Number of relevant m	onitoring wells with groundv	vater data:				None
		Number of wells relative	vo to transment zono:	Pre-treatment:		Post-treatment:		
		Pre-treatment		I la ava dianti	Down are dient.	Con	and diant	
			In:	Upgradient:				
		Post-treatment	In:	Upgradient:	Downgradient:		ssgradient	
Soil	Borings:	Number of relevant soi	l borings with pre-treatment	data:				
		Number of relevant soi	l borings with post-treatmen	t data:				
		Number inside treatme	nt zone:	Number outside	treatment zone:			
Туре	s of Con	taminants		1			11	
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	<u>x</u>	Trichloroethene	Hexane	Creosote	None	50 mg/kg	None	0.01 mg/kg
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemica	lo of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Conce		1,1,2-trichloroethane			None	None	entration per Average Post-treatmer Chem ill (mg/kg) Groundwater (mg/L) None one None	None
		1,1,2,2-tetrachloroethane			None	Post-treatment:	None	
		Vinyl Chloride			None	None	None	None
	_				None	None	None	None
					None	None	None	None
	_				None	None	None	None
	_				None	None	None	None
					None	None	None	None
					None	None	None	None
0								
Co	omments:	·						
		<u> </u>						
Attac	chments:	<u> </u>						
		-						-

Hydr	rogeologic Conceptual	Model		Facility ID#: 0568
	_Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated see Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated see Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material higher permeability material diments sediments wer permeability material
			adjacent to treatment zone: ft amsl	Unknown
<u>X</u>	Aquifer Characteristic			
	Is more than 1 aquife	r present?		nknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3 2 6 ———————————————————————————————	
	_ Flow direction			
	Horizontal hydraulic g			Unknown
	_ K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
	Transmissivity (ft2/da	low high y): Measured low high		Unknown Field data Unknown
	Comments:			
	Attachments:			

The	rmal Treatment - Design							Facility ID#:	0568	
<u>x</u>	Thermal treatment:		_ Conductiv	e						
		<u>x</u>	Electrical	Resistance						
				_ 3 phase		_ 6 phase	AC pow	DC	power	
			_ Steam	Steam		_ Steam + air	Steam +	O2		
			Other (des	scribe)						
	Type of Test:	Pilot	test	Full-	-scale Syste	m				
	_Geology of Treatment Zone	e:		_ Relatively	homogen	eous and permea	ble unconsolida	ted sediments		
				_ Relatively	homogen	eous and imperm	eable unconsoli	dated sediments		
								es of lower perme	-	
				_ Largely in	npermeable	e sediments with	inter-bedded lay	ers of higher peri	neability material	
						ured bedrock (i.e	-	()		
					d bedrock,	limestone, sands	stone			
-	_ Treatment Targe Zone:		_ Saturated	d only	Vac	-		turated and Vadose	zones)	
<u>X</u>	Start of Thermal Test:		/2006			Duration:	82d			
	_ Hydraulic Control	_	_ Yes	No						
	Treatment Cell Design:									
<u>x</u>	Size of target zone (ft2):				1600		11.	nknown (_ x ft)	
	Thickness of target zone (ft	٠١٠			20		<u> </u>	nknown	_ x it)	
	Depth to top of target zone		ıs).		2		<u> </u>	ıknown		
	Thickness of target zone be			(ft):	20			Unknown		
	Number of energy delivery			()			Uı			
	Number of extraction points	-			Unknown					
	·									
<u>x</u>	Temperature Profile:									
	Initial formation temperature	e (de	g C):			<u>13</u>		Unknown	1	
	Maximum representative for	rmati	on tempera	ature (deg C	:):	<u>77</u>		Unknown	1	
	Time to reach maximum re	prese	ntative tem	perature (da	ays):	<u>25</u>		Unknown	ı	
	Duration of treatment at rep	oreser	ntative tem	perature (da	ays):	<u>57</u>		Unknow	1	
						<u>Dat</u>	t <u>e</u>	Temperatu	re (deg C)	
	Formation temperature imn	nediat	tely post-tre	eatment:						
	Formation temperature pos	t-trea	tment mon	itoring even	t 1:					
	Duration of post-treatment	monit	oring (days	s):						
	_ Mass of contaminant remov	ved:								
	Via I	iquid	pumping:				lb	kg	Unknown	
	In va	por s	tream:				lb	kg	Unknown	
	Tota	l:					lb	kg	Unknown	
	Comments:									
		-								
	Attachments:									

Cos	st and Performance						Facility ID#:	<u>0568</u>
	_ Performance							
	Remediation Goal:							
		In Groundwater: —						
		<u> </u>						
		In Soil:						
	Was the Remediation							
	_	In Groundwater						
		Comment: —						•
		_						
	_	In Soil						
		Comment: —						
		_						
	General comments	on the thermal applica	ation:					
	Lessons Learned							
	F							
<u>x</u>	Energy	054040			1 3371	kWhr/m ³		NA/IL/I3
	Total Energy Used:	·		<u>x</u>	KWnr			
		tal energy applied to tr	reatment zone:				_ kWhr/m³	kWhr/yd ³
	Oth	ner energy:	_			-	_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:					
	_ Cost							
	Total Project Cost:							
	-	nsultant Cost:			_			
		ermal Vendor Cost:			-			
		ergy Cost:			-	m ³	_ yd³	
		ner Cost 1:					_ , .	
		ner Cost 2:			-			
		ner Cost 3:			-			
	Please note of		Other Cost 1:		=			
	1 10000 11010 01		Other Cost 2:					
			0.1.01 0031 2.					

____ Other Cost 3:

<u>X</u> PD ____ File Analyzed By: Date: 11/9/2006 Type of treatment: Conductive __Steam X ERH ____Other: Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Pesticides _Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: ___ Pilot Test X Full Scale System Start of Test: 9/11/2003 End of Test: 5/11/2004 Duration: 242 d Type of Site: ___Non-DOD DoD <u>X</u> Facility Name: Camp LeJeune Address: City, State, Zip Code: Jacksonville, NC OU# or Site #: Site 89 Primary point of contact: Ron Kenyon Organization: Address: City, State, Zip Code: Alpharetta, GA Phone #: <u>770-663-1453</u> email: ronald.kenyon@shawgrp.com Other contacts or vendors who worked on site _ None Point of contact: Daniel Hood Type: _ Vendor, Consultant ___ Vendor, Technical Applications Other Organization: Navy Address: 6506 Hampton Blvd City, State, Zip Code: Norfolk, VA 23508-4530 Phone #: <u>757-322-4630</u> email: daniel.r.hood@navy.mil QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data __Good pre- and post-treatment soil data ____ Good temperature profile vs. time information _ Flux assessment ____ Groundwater elevations _Geologic cross-section ___ Hydraulic Conductivity information

Facility ID#:

0570

General Site Information

General Site	Assessment	Data						F	Facility ID#:	0570
X Impacte	ed Zone:		as defined by documentation				iness (ft):		<u>X</u>	Unknown
		Alternative meth	od for determining size of im	npacted zone (See	source zor	ne definition attachmer	nts)			
X Monito	r Wells:	Number of relevant m	nonitoring wells with ground	water data:					_	None
				Pre-t	treatment:	<u>27</u>	Post-treatment:	<u>27</u>		
		Number of wells relat Pre-treatment	tive to treatment zone:	Upgradient:	2	Downgradient:	£ 0	ossgradient:	0	
		Post-treatment	In: 10		2	Downgradient:	_	ossgradient:	<u>9</u> <u>9</u>	
			<u></u>		=			9	-	
X Soil Bor	ings:	Number of relevant so	oil borings with pre-treatment	t data:	<u>31</u>					
		Number of relevant so	oil borings with post-treatmer	nt data:	31					
		Number inside treatme	ent zone: 20	Numi	ber outside	treatment zone:				
X Types o	f Contamina	ints	1							
						Average Pre-treatme	ent Concentration per nical:	Average Po	st-treatment Chemica	Concentration per al:
	C	hlorinated Solvents	Petroleum Hydrocarbons	Other		Groundwater (mg/L)	Soil (mg/kg)	Groundwater	(mg/L)	Soil (mg/kg)
	X Trie	chloroethene	Hexane	Creosote		500 mg/L	500 mg/kg	5 mg/L		10 mg/kg
	X Tet	rachloroethene	Jet Fuel			10 mg/L	None	0.1 mg/L		None
	1,1-	-dichloroethene	Napthalene			None	None	None		None
	X cis-	1,2-dichloroethene	Benzene			100 mg/L	50 mg/kg	10 mg/L		5 mg/kg
	X tran	ns-1,2-dichloroethene	Tolune			50 mg/L	50 mg/kg	0.1 mg/L		0.5 mg/kg
	1,1-	-dichloroethane	Ethylbenzene			None	None	None		None
	1,2-	-dichloroethane	m/p-xylene			None	None	None		None
Chemicals of	1,1,	,1-trichloroethane	o-xylene	<u>x</u>		0.5 mg/L	5 mg/kg	0.01 mg/L		0.01 mg/kg
Concern		,2-trichloroethane				10 mg/L	50 mg/kg	0.1 mg/L		0.5 mg/kg
	<u>X</u> 1,1,	2,2-tetrachloroethane				100 mg/L	1,000 mg/kg	0.5 mg/L		0.5 mg/kg
	X Vin	yl Chloride				10 mg/L	None	0.05 mg/L	_	None
		E - Deep				10 mg/L	50 mg/kg	0.5 mg/L		0.05 mg/kg
		E - Deep				0.5 mg/L	None	0.1 mg/L	_	None
		12 DCE - Deep				1 mg/L	5 mg/kg	0.1 mg/L		0.05 mg/kg
		ns-12 DCE - Deep				0.5 mg/L	5 mg/kg	0.01 mg/L		0.01 mg/kg
		22 PCA - Deep				10 mg/L	5 mg/kg	0.01 mg/L		0.01 mg/kg
	X VC	- Deep				0.1 mg/L	None	0.01 mg/L		None
	_	hallow wells screened	to 15 ft bgs. Deep wells s and 1122 PCA - Dee			Average post-treatme lown as 0.01 mg/Kg			eep, trans	;-12 DCE - Deep
Attachm	ents:									
	_									
	_									

Hyd	rogeologic Conceptual	Model						Facility ID#:	<u>0570</u>		
<u>X</u>	Geology:	<u>Zone</u>	Unconsolid	lated Sedin	nents_						
		Vadose Zone:	Relati	vely homo	geneous and per	meable unconso	lidated sec	liments			
			Relati	vely homo	geneous and imp	ermeable uncon	solidated s	ediments			
			X Large	ly permeab	le sediments wit	h inter-bedded le	enses of lov	wer permeability	material		
			Large	ly imperme	able sediments	with inter-bedded	l layers of l	nigher permeab	ility material		
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weath	nered bedro	ock, limestone, s	andstone					
		Saturated Zone:	Relati	vely homo	geneous and per	meable unconso	lidated sec	liments			
			Relati	vely homo	geneous and imp	ermeable uncon	solidated s	ediments			
			X Large	ly permeab	le sediments wit	h inter-bedded le	enses of lov	wer permeability	material		
			Large	ly imperme	able sediments	with inter-bedded	l layers of l	higher permeab	ility material		
			Comp	etent, but f	ractured bedrock	(i.e. crystalline	rock)				
			Weath	nered bedro	ock, limestone, s	andstone					
<u>×</u>	_Aquifer Characteristic		No Aquifer	Yes	(number):			known (assume s	Jnknown ingle aquifer)		
	Depth to water:	low value (ft bgs):	<u>3</u>	•	Aquilei 2	Aq	uliel 5				
	Dopur to water.	high value (ft bgs):	<u>5</u>								
		Unknown:	_								
<u>X</u>	Flow direction		<u>SE</u>								
<u>X</u>	Horizontal hydraulic g		0.002					· <u></u>	Jnknown		
	Vertical hydraulic gra	dient (feet/foot):							Jnknown		
<u>X</u>	K range (ft/day)	Measured	using:	Slug	Test	_ Laboratory		Field data			
		low	8.4					t	Jnknown		
		high	<u>64.6</u>								
	Transmissivity (ft2/da	y): Measured	using:	Slug	Test	Laboratory	_	Field data			
		low						t	Jnknown		
		high									

Comments:

Attachments:

The	rmal Treatment - Design								Facility ID#:	<u>0570</u>
<u>X</u>	Thermal treatment:		_ Conductiv	ve						
		<u>X</u>	Electrical	Resistance						
			_	3 phase		6 phase		_AC power	DC	power
			_ Steam	Steam		Steam + air		_ Steam + C)2	
			Other (de	scribe)						
<u>X</u>	Type of Test:	Pilot	test	X Full-	scale System					
<u>X</u>	Geology of Treatment Zone	e:		Relatively	homogene	ous and perr	neable un	consolidate	ed sediments	
				Relatively	homogene	ous and impe	ermeable	unconsolid	ated sediments	
			<u>x</u>	Largely pe	ermeable se	diments with	n inter-bed	lded lenses	s of lower perme	ability material
				Largely im	npermeable	sediments w	ith inter-b	edded laye	ers of higher peri	meability material
				Competer	nt, but fractu	red bedrock	(i.e. cryst	alline rock)	1	
				Weathere	d bedrock, I	imestone, sa	andstone			
<u>X</u>	Treatment Targe Zone:		_ Saturate	d only	Vado	se only	<u>X</u>	Both (Sati	urated and Vadose	zones)
<u>X</u>	Start of Thermal Test:	9/11/	/2003			Durat	ion: <u>242</u>	<u>d</u>		
<u>X</u>	Hydraulic Control	<u>X</u>	Yes	No						
<u>X</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>15873</u>			Unl	cnown (80 x 214 ft)
	Thickness of target zone (ft):			<u>21</u>			Unl	cnown	
	Depth to top of target zone	(ft bg	s):		<u>5</u>			Unl	cnown	
	Thickness of target zone be	elow v	water table	(ft):	<u>21</u>			Unl	cnown	
	Number of energy delivery	points	s:		<u>91</u>			Unl	cnown	
	Number of extraction points	S:			<u>38</u>			Unl	known	
<u>x</u>	Temperature Profile:									
	Initial formation temperature	e (de	g C):			<u>20</u>			Unknowi	1
	Maximum representative fo	rmati	on temper	ature (deg C):	<u>100</u>			Unknow	1
	Time to reach maximum re	orese	ntative ten	nperature (da	ays):	<u>~156</u>			Unknow	1
	Duration of treatment at rep	reser	ntative tem	nperature (da	ays):	<u>~86</u>			Unknow	ı
							<u>Date</u>		Temperatu	re (deg C)
	Formation temperature imn	nediat	tely post-tr	eatment:						
	Formation temperature pos	t-trea	tment mor	nitoring even	t 1:					
	Duration of post-treatment	monit	oring (day	s):		<u>1 yr</u>				
<u>x</u>	Mass of contaminant remov	رمط·								
Δ			pumping:		<u>428</u>		<u>x</u>	lb	kg	Unknown
			tream:		48000		<u>X</u>	lb	kg	Unknown
	Tota		aroum.		48428		<u>X</u>	lb	kg	Unknown
	. 5.0.0				_10.12.	2	-	10	^	<u></u>
	Comments:									
	<u>Only 75%</u>	on t	ime (~17!	5 d).						
	Attachments:			/-						

Cos	t and Performand	се							Facility ID#:	<u>0570</u>	
<u>X</u>	Performance										
	Remediation G	oal:									
		Χ	In Groundwater:								
		_				95%	reduction in gr	oundwate	er.		
		<u>X</u>	In Soil:						_		
		_				959	% reduction in :	soil			
						<u>55,</u>	, , , , , , , , , , , , , , , , , , , ,	55			
	Was the Remed	diatior	Goal Achieved:								
		<u>X</u>	In Groundwater								
			Comment:								
				99%	6 in treatment zone ar	nd 97% in pe	erimeter zone.				
		<u>X</u>	In Soil								
			Comment:								
				Yes	<u>s.</u>						
	General comme	ents o	n the thermal app	licati	on:						
	Objective: Evaluate effectiveness of ERH at reducing DNAPL within study area.										
	Lessons Learne	ed									
<u>X</u>	Energy										
	Total Energy U	sed:	1,74	8,660	<u>0</u>	X kW	hrk	:Whr/m ³	kV	Vhr/yd ³	
		_ Tota	al energy applied t	o tre	atment zone:				kWhr/m ³	kWhr/yd ³	
			er energy:						kWhr/m ³	kWhr/yd ³	
			Plea	se no	ote other energy:		_				
					5,						
<u>X</u>	Cost										
	Total Project Co	ost:		2	2,105,21 <u>5</u>						
		_ Con	sultant Cost:								
		_ The	rmal Vendor Cost	:							
		_ Ene	rgy Cost:				m ³		yd ³		
	<u>X</u>	Oth	er Cost 1:		907,400						
	<u>X</u>	Oth	er Cost 2:		672,550						
	<u></u>		er Cost 3:		<u>525,265</u>						
	X Please no			X	Other Cost 1:			System C) & M		
	_			<u></u>	Other Cost 2:						
				<u>X</u>	Other Cost 3:	Site prep, r	estoration, mo	nitoring, a 169,58		31,275; 324,410;	
				_							

General Site Information Facility ID#: 0573 <u>X</u> PD ____ File Analyzed By: Date: 10/18/2006 ____Steam Type of treatment: _Conductive X ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _ Wood Treating _Other: Treatment Status: \underline{X} Post ____ Active Type of Test: ___ Pilot Test ___ Full Scale System Start of Test: 12/4/2003 End of Test: 7/8/2004 Duration: 238 d Type of Site: X Non-DOD __ DoD Facility Name: Confidential Address: City, State, Zip Code: NC OU# or Site #: Primary point of contact: Brett Berra Organization: Address: City, State, Zip Code: Phone #: 919-461-1290 email: brett_berra@urscorp.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

General Site	Assess	sment Data					Facility II	D#: <u>0573</u>
Impac	ted Zon	Impacted zone	w direction)(ft.):as defined by documentation			iness (ft):		Unknown
		Map attachmen	-	ipacied zone (See Source zo	one definition attachmen	ns)		
Monit	or Wells	S: Number of relevant r	monitoring wells with grounds			Destauration		None
		Number of wells rela	ative to treatment zone:	Pre-treatment:		Post-treatment:		
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
Soil Bo	orings:	Number of relevant se	oil borings with pre-treatment	data:				
		Number of relevant so	oil borings with post-treatmer	nt data:				
		Number inside treatm	nent zone:	_ Number outside	e treatment zone:			
X Types	of Cont	aminants						
_ //					Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	X	Trichloroethene	Hexane	Creosote	None	None	None	None
	x	Tetrachloroethene	Jet Fuel		None	None	None	None
	<u>x</u>	1,1-dichloroethene	Napthalene		None	None	None	None
	X	cis-1,2-dichloroethene	Benzene		None	None	None	None
	^	trans-1,2-dichloroethene	Tolune		None	None	None	None
	-	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	<u>X</u>	1,2-dichloroethane	m/p-xylene		None	None	None	None
	<u>X</u>	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals	of	1,1,2-trichloroethane	o-xylelie		None	None	None	None
Concern		1,1,2,2-tetrachloroethane			None	None	None	None
	<u>x</u>	Vinyl Chloride			None	None	None	None
	<u>X</u>	Carbon tetrachloride			None	None	None	None
	<u>X</u>	Chloroform			None	None	None	None
	<u>~</u>	CHOIOIM	X Benzene		None	None	None	None
	X	Total VOCs	<u>A</u> <u>Bennone</u>		None	5 mg/kg	None	None
	=				None	None	None	None
					None	None	None	None
		_	1		1	1		
Com	ments:							
Attach	ments:							
,								
		-						

Hyd	rogeologic Conceptual	Model				Facility ID#:	0573				
<u>X</u>	Geology:	<u>Zone</u>	Unconsolidated S	Sediments							
		Vadose Zone:	Relatively h	omogeneous and permeable	unconsolidated sed	liments					
			Relatively h	omogeneous and impermeat	ole unconsolidated s	ediments					
			Largely per	meable sediments with inter-	bedded lenses of lov	ver permeability mate	rial				
			X Largely imp	ermeable sediments with inte	er-bedded layers of h	nigher permeability ma	aterial				
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments								
			Relatively h	omogeneous and impermeat	ole unconsolidated s	ediments					
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			X Largely imp	ermeable sediments with inte	er-bedded layers of I	nigher permeability ma	aterial				
			Competent,	but fractured bedrock (i.e. cr	ystalline rock)						
			Weathered	bedrock, limestone, sandstor	ne						
X	Aquifer Characteristic Is more than 1 aquife Depth to water:		No Aquifer 1 <u>X</u>	Yes (number): Aquifer 2	<u>X</u> Un Aquifer 3	known (assume single a	quifer)				
	_ Flow direction										
	_ Horizontal hydraulic g	gradient (feet/foot):				Unknow	/n				
	Vertical hydraulic grad	dient (feet/foot):				Unknow	/n				
	_ K range (ft/day)	Measured	using:	Slug Test Labora	ntory	Field data					
		low		<u> </u>		Unknow	n/n				
		high		<u> </u>							
	Transmissivity (ft2/da	y): Measured	using:	Slug Test Labora	ntory	Field data					
		low		_		Unknow	n/n				
		high									

Comments:

Attachments:

The	rmal Treatment - Design								Facility ID#:	<u>0573</u>
<u>X</u>	Thermal treatment:		_ Conductiv	re						
		<u>X</u>	Electrical	Resistance						
				_ 3 phase	<u>X</u>	6 phase		_ AC power	er DC	power
			_ Steam	C				G	02	
			Other (dee	_ Steam		_ Steam + air	_	Steam +	02	
~	Type of Teets	D:1	Other (des							
<u>X</u>	Type of Test:	_ Pilot		_	-scale Syster		maabla u	nconcolido	tod codiments	
	_ Geology of Treatment Zone	₽.							ted sediments dated sediments	
									es of lower perme	ability material
			<u>X</u>						•	meability material
			<u>~</u>		•	ured bedrock		-		neability material
			-	_		limestone, s			9	
<u>X</u>	Treatment Targe Zone:		Saturated		Vad		<u>X</u>		turated and Vadose	zones)
<u>X</u>	Start of Thermal Test:		/2003	,		-	ition: <u>238</u>			,
_	_ Hydraulic Control		Yes	No						
	- /		_							
<u>X</u>	Treatment Cell Design:									
	Size of target zone (ft2):				12833			Ur	nknown (90 x 155 ft)
	Thickness of target zone (f	t):			<u>12</u>			Ur	nknown	
	Depth to top of target zone	(ft bg	s):		<u>2</u>			Ur	nknown	
	Thickness of target zone be	elow v	water table	(ft):	<u>10</u>			Ur	nknown	
	Number of energy delivery	points	s:		<u>62</u>			Ur	ıknown	
	Number of extraction points	s:			<u>22</u>			Ur	ıknown	
<u>x</u>	Temperature Profile:									
	Initial formation temperatur	e (de	g C):			<u>18</u>			Unknow	1
	Maximum representative for	ormati	on tempera	ature (deg C	C):	<u>91</u>			Unknow	ı
	Time to reach maximum re	prese	ntative tem	nperature (d	lays):	~136			Unknow	ı
	Duration of treatment at rep	presei	ntative tem	perature (da	ays):	~102			Unknow	1
							<u>Date</u>		Temperatu	re (deg C)
	Formation temperature imp	nedia	tely post-tre	eatment:						
	Formation temperature pos	st-trea	tment mon	itoring ever	nt 1:					
	Duration of post-treatment	monit	oring (days	s):						
<u>X</u>	Mass of contaminant remove	ved:								
	Via	liquid	pumping:	_				lb	kg	Unknown
	In va	apor s	tream:		542	9	<u>X</u>	lb	kg	Unknown
	Tota	ıl:			<u>542</u>	9	X	lb	kg	Unknown
	Comments:									
	Attachments:									

Performance	,			
Remediation				
Remediation		In Groundwater:		
	<u>X</u>	in Groundwater:	Decrees and acceptable abit on MOI and the abit is a	
	V	In Cail.	Remove source and eventually achieve MCLs after polishing ac	<u>jents were applied</u> .
	<u>X</u>	In Soil:	2	
			<u>Same as above</u>	
Was the Re	mediatio	on Goal Achieved:		
		In Groundwater		
		Comment: -		
		-		
		In Soil		
		Comment: -		
		_		
General con	nments	on the thermal applica	ation:	
<u>95% re</u>	eduction	in total VOCs in GW	. 80% reduction in total VOCs in soil.	
Lessons Lea	arned			
				
_ Energy				
Total Energy	, I lsed.		kWhrkWhr/m ³	kWhr/yd ³
Total Energy		tal energy applied to t		
-		ner energy:	kWhr/m	
_	Ou			KVVIII/yd
		Please	note other energy:	
_ Cost				
– Total Projec	t Cost:			
		nsultant Cost:		
-		ermal Vendor Cost:		
=		ergy Cost:	m³yd³	
-			yu	
=		ner Cost 1:		
-		ner Cost 2:		
_		ner Cost 3:		
Please	note ot	ther cost:	Other Cost 1:	
			Other Cost 2:	

__ Other Cost 3:

Facility ID#:

<u>0573</u>

Cost and Performance

PD ____ File Analyzed By: Date: 11/1/2006 Type of treatment: _Conductive ____ Steam ____Other: Type of Contaminant: _____Pesticides _Chlorinated Solvents Petroleum Hydrocarbons __ Wood Treating Other: Treatment Status: Active Post ___ Full Scale System Type of Test: Pilot Test Start of Test: End of Test: _____ Duration: 120 d Type of Site: Non-DOD __ DoD Facility Name: Total Petrochemicals USA, Inc. (Pilot) Address: City, State, Zip Code: Greensboro, NC OU# or Site #: Primary point of contact: Monty Bennett or Rusty Field Organization: Address: City, State, Zip Code: Phone #: 804-343-0700 email: rfield@gesonline.com Other contacts or vendors who worked on site _ None Point of contact: Dacre Bush Type: Vendor, Consultant ____ Vendor, Technical Applications __Other Organization: McMillan-McGee Address: City, State, Zip Code: Phone #: 805-295-9071 email: dacre.bush@mcmillan-mcgee.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0575

General Site Information

___ Hydraulic Conductivity information

General Site As	sessment Data					Facility II	D#: <u>0575</u>
Impacted	Impacted zone a	v direction)(ft.): s defined by documentation od for determining size of im			ness (ft):		Unknown
	Map attachment						
Monitor V	Vells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	ive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	=	il borings with pre-treatment					
	Number of relevant so	il borings with post-treatmer	nt data:				
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
x Types of 0	Contaminants						
		Average Post-treatm Chen	ent Concentration per nical:				
1	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane	x <u>TBA</u>		None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
Attachmer	nts:						
	-						

Hydro	ogeologic Conceptual	Model		Facility ID#:	0575						
	Geology:	<u>Zone</u>	Unconsolidated Sediments								
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated see	diments							
			Relatively homogeneous and impermeable unconsolidated	sediments							
			Largely permeable sediments with inter-bedded lenses of lo	wer permeability material							
			Largely impermeable sediments with inter-bedded layers of	higher permeability mater	rial						
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated sediments								
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			Largely impermeable sediments with inter-bedded layers of higher permeability material								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
	Ground surface eleva	ation based on wells in o	adjacent to treatment zone: ft amsl	Unknown							
	Aquifer Characteristic	es:									
	Is more than 1 aquife	r present?	No Yes (number): U	nknown (assume single aquif	fer)						
			Aquifer 1 Aquifer 2 Aquifer 3								
	Depth to water:	low value (ft bgs):		-							
		high value (ft bgs):		-							
		Unknown:		-							
	Flow direction			-							
	Horizontal hydraulic g	gradient (feet/foot):		Unknown							
	Vertical hydraulic gra	dient (feet/foot):		Unknown							
	K range (ft/day)	Measured	using: Slug Test Laboratory	Field data							
		low		Unknown							
		high		=							
	Transmissivity (ft2/da	y): Measured	using: Slug Test Laboratory	Field data							
		low		Unknown							
		high		-							
	Comments:										
	Attachments:										

The	rmal Treatment - Design								Facility	ID#:	<u>0575</u>
<u>x</u>	Thermal treatment:	c	onductive								
		<u>x</u> E	lectrical R	esistance							
				3 phase		6 phase		AC pov	ver _	DC 1	power
		S	team								
				Steam		Steam + air		_Steam -	- O2		
			ther (desc								
<u>x</u>	Type of Test: <u>x</u>	Pilot tes			scale System						
	_Geology of Treatment Zone	e:			-	ous and permea					
				-	-	ous and imperm					
			· · · · · ·			diments with in					•
										ier perm	eability material
				•		red bedrock (i.e	-	alline roc	ck)		
	Transfer and Targe 7ana.					imestone, sand		D . 41. 70		37. 1	
	_ Treatment Targe Zone: _ Start of Thermal Test:	°	aturated (Offig	vado	se only					cones)
	_ Start of Thermal Test. _ Hydraulic Control	v	es	No		Duration	·				
	_ Trydraulic Control		Co								
	_ Treatment Cell Design:										
	Size of target zone (ft2):							U	nknown	(x ft)
	Thickness of target zone (f	t):					_		nknown	\	
	Depth to top of target zone	•					_		nknown		
	Thickness of target zone b	elow wat	er table (f	ft):	·		_	U	nknown		
	Number of energy delivery	points:					_	U	nknown		
	Number of extraction point	s:					_	U	nknown		
<u>x</u>	Temperature Profile:										
	Initial formation temperatur	e (deg C):						U	nknown	
	Maximum representative for	rmation	temperat	ure (deg C)	:	<u>105</u>			U	nknown	
	Time to reach maximum re	presenta	tive temp	erature (da	ys):				U	nknown	
	Duration of treatment at re	oresenta	tive temp	erature (day	ys):				U	nknown	
						<u>Da</u>	<u>ite</u>		Tem	perature	e (deg C)
	Formation temperature imr	-									
	Formation temperature pos			-	1:				-		
	Duration of post-treatment	monitorii	ng (days):	:					-		
v	Mass of contaminant remo	vod:									
<u>X</u>		iquid pui	mnina.					lb	k	σ	Unknow
		apor stre						_	k		Unknow
	Tota		um.		69000)	<u>x</u>	lb	k	_	Unknow
	100				0,000	<u> </u>	Δ.	10		,	Chanow
	Comments:										
	23 foot s	<u>oacin</u> q									
	Attachments:										

Cost and Performance					Facility ID#:	<u>0575</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
_						
_	In Soil:					
_						
Was the Remediat	ion Goal Achieved:					
-	In Groundwater					
	Comment: -					
	-					
_	In Soil					
	Comment: -					
	_					
General comments	s on the thermal applica	ation:				
Lessons Learned						
<u>x</u> Energy						
Total Energy Used	: <u>186</u>		kWhr	kWhr/m ³	<u>x</u> k'	Whr/yd ³
To	otal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd ³
0	ther energy:				_ kWhr/m ³	kWhr/yd ³
	Please	note other energy:				
Cost						
Total Project Cost:						
C	onsultant Cost:					
TI	hermal Vendor Cost:					
E	nergy Cost:			m ³	_ yd³	
0	ther Cost 1:					
0	ther Cost 2:					
0	ther Cost 3:					
Please note of	other cost:	Other Cost 1:				
		Other Cost 2:				

__ Other Cost 3:

PD ____ File Analyzed By: Date: 11/1/2006 Type of treatment: _Conductive ____ Steam ____Other: Type of Contaminant: _____Pesticides _Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: Post Active Type of Test: Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: 120 d Type of Site: __ DoD Non-DOD Facility Name: Total Petrochemicals USA, Inc. (Full) Address: City, State, Zip Code: Greensboro, NC OU# or Site #: Primary point of contact: Monty Bennett or Rusty Field Organization: Address: City, State, Zip Code: Phone #: 804-343-0700 email: rfield@gesonline.com Other contacts or vendors who worked on site _None Point of contact: Dacre Bush Type: Vendor, Consultant ____ Vendor, Technical Applications __Other Organization: McMillan-McGee Address: City, State, Zip Code: Phone #: 805-295-9071 email: dacre.bush@mcmillan-mcgee.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0576

General Site Information

___ Hydraulic Conductivity information

General Site As	ssessment Data					Facility II	D#: <u>0576</u>
Impacted	Impacted zone a				ness (ft):		Unknown
Monitor	Wells: Number of relevant m	nonitoring wells with ground					None
	Number of wells relat Pre-treatment Post-treatment	In:	Pre-treatment: Upgradient: Upgradient:	Downgradient:		ssgradient:	
Soil Borin	=	il borings with pre-treatment il borings with post-treatmer ent zone:	nt data:	treatment zone:			
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
- - -	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane	x TBA		None	None	None	None
Concern	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
		<u> </u>		110110	110110	Tione	110110
Comme	ents:						
	-						
Attachme	nts:						
	-						
	-						

Hydro	geologic Conceptual	Model		Facility ID#:	0576						
	Geology:	<u>Zone</u>	Unconsolidated Sediments								
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sec	diments							
			Relatively homogeneous and impermeable unconsolidated	sediments							
			Largely permeable sediments with inter-bedded lenses of lo	wer permeability material							
			Largely impermeable sediments with inter-bedded layers of higher permeability material								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sec	diments							
			Relatively homogeneous and impermeable unconsolidated	sediments							
			Largely permeable sediments with inter-bedded lenses of lo	wer permeability material							
			Largely impermeable sediments with inter-bedded layers of	higher permeability mater	rial						
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
	Ground surface eleva	ation based on wells in o	adjacent to treatment zone: ft amsl	Unknown							
	Aquifer Characteristic	os:									
	Is more than 1 aquife	r present?	No Yes (number): Ur	nknown (assume single aquif	fer)						
			Aquifer 1 Aquifer 2 Aquifer 3								
	Depth to water:	low value (ft bgs):		-							
		high value (ft bgs):		-							
		Unknown:		-							
	Flow direction			-							
	Horizontal hydraulic	gradient (feet/foot):		Unknown							
	Vertical hydraulic gra	dient (feet/foot):		Unknown							
	K range (ft/day)	Measured	using: Slug Test Laboratory	Field data							
		low		Unknown							
		high		=							
	Transmissivity (ft2/da	ay): Measured	using: Slug Test Laboratory	Field data							
		low		Unknown							
		high		_							
	Comments:										
	Attachments:	-									
				_							

The	rmal Treatment - Design						F	acility ID#:	0576
<u>x</u>	Thermal treatment:		_ Conductive						
		<u>x</u>	Electrical Resis	stance					
			3 p	bhase	6 phase	A	C power	DC	power
			_ Steam						
			Ste	eam	Steam + air	St	eam + O2		
			Other (describe	e)					
<u>x</u>	Type of Test:	Pilot	test <u>x</u>	Full-scale	e System				
	_Geology of Treatment Zone	e :	Re	elatively hor	mogeneous and per	meable uncon	solidated s	ediments	
				-	nogeneous and imp				
					eable sediments with			•	-
					meable sediments v			of higher perr	neability material
			·	•	ut fractured bedrock		ne rock)		
	Total total and Total Total		·		edrock, limestone, sa		1.00	1 177 1	
	_Treatment Targe Zone: Start of Thermal Test:		_ Saturated only	у	-	Bo			
	_ Start of Thermal Test: _ Hydraulic Control		Vac	No	Dura	uon:			
	_ riyuraulic Control		Yes	No					
	_Treatment Cell Design:								
	Size of target zone (ft2):						Unknov	vn (_ x ft)
	Thickness of target zone (ft	:):					Unknov		
	Depth to top of target zone		ıs):				Unknov		
	Thickness of target zone be	elow v	water table (ft):				Unknov	vn	
	Number of energy delivery	points	s:			_	Unknov	vn	
	Number of extraction points	s:					Unknov	vn	
<u>x</u>	Temperature Profile:								
	Initial formation temperature	e (de	g C):					Unknown	
	Maximum representative for	rmati	on temperature	(deg C):				Unknown	
	Time to reach maximum re	prese	ntative tempera	ature (days)	:			Unknown	
	Duration of treatment at rep	reser	ntative tempera	ture (days):				Unknown	
						_		_	
	Farmation to an arration in a	!!	t - h t t t			<u>Date</u>		Temperatu	re (deg C)
	Formation temperature imn Formation temperature pos								
	Duration of post-treatment			ig event 1.					
	Duration of post-freatment	monit	oning (days).						
<u>x</u>	Mass of contaminant remov	ved:							
_			pumping:			lb	_	kg	Unknown
	In va	por s	tream:			lb		kg	Unknown
	Tota	I:				lb		kg	Unknown
	Comments:								
	23 foot sp	acin	g						
	Attachments:								

Cos	st and Performance					Facility ID#:	<u>0576</u>
	_ Performance						
	Remediation Goal:						
		In Groundwater: —					
		_					
		In Soil:					
	_	-					
		·					
	Was the Remediation	on Goal Achieved:					
	_	In Groundwater					
		Comment: -					
		_					
		In Soil					
		Comment: -					
	General comments	on the thermal applica	ation:				
	Lessons Learned						
							
<u>x</u>	Energy						
_	Total Energy Used:			kWhr	kWhr/m ³	k	Whr/vd ³
	0,	tal energy applied to to	reatment zone:			 _ kWhr/m³	kWhr/yd ³
		her energy:				_ kWhr/m³	kWhr/yd ³
	0		note other energy:			_ KVVIII/III	KVVIII/yd
		Flease	note other energy:				
	_ Cost						
	Total Project Cost:						
	Co	nsultant Cost:					
		ermal Vendor Cost:					
		ergy Cost:				_ yd³	
	·	her Cost 1:			···· <u></u>	-,~	
		her Cost 2:					
							
	·	her Cost 3:	Othor Co-t 4:				
	Please note of	mer cost:	Other Cost 1:				
			Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD			Date	ə:
	Type of treatment:	Conductive	Steam	<u>x</u> ERH	Other:	·
	Type of Contaminant:	Chlorinated Solve	ents	Petroleum Hydrocarb		_Pesticides
		<u>x</u> Wood Treating	·	Other:		
	Treatment Status:	Active	<u>x</u> Post			
	Type of Test:	<u>x</u> Pilot Test	Full Scale	e System		
	Start of Test:	10/1/2004	End	of Test: <u>2/14/2004</u>	Du	ration: 137 d
	Type of Site:	<u>x</u> Non-DOD	DoD			
<u>x</u>	Facility Name: <u>Cape Fear</u>	Wood Preserving				
	Address: <u>1219 Sout</u>	h Reilly Rd				
	City, State, Zip Code:	Fayetteville, NC				
	OU# or Site #:					
<u>x</u>	Primary point of contact:	Chad Northington				
_	• •	astructure and Environme	nt. Inc.			
	Address: 221 Hobs St., St		,			
	City, State, Zip Code:	Tampa, FL 33619				
	Phone #: 813-383-0309	Tampa, FL 33017	amail: and	orthington@wrsie.com		
	Filolie #. <u>813-383-0309</u>		eman. <u>enc</u>	runngton@wrste.com		
<u>x</u>	Other contacts or vendors when	ho worked on site		None		
	Point of contact: <u>Dac</u>	re Bush				
	Type: \underline{x} Vendor, C	onsultant	Vendor, Techni	cal Applications	Other	
	Organization: McMillian	n-McGee				
	Address:					
	City, State, Zip Code:					
	Phone #: 805-295-9071		email: <u>dac</u>	re.bush@mcmillian-mcg	gee.com	
Q	A/QC					
	_ Characteristics of Interest					
	Good pre- and post-tre	eatment groundwater data		Good pre- and p	post-treatment soil c	lata
	Good temperature prof			Flux assessmen	t	
	Groundwater elevation			Geologic cross-		
	Hydraulic Conductivit					
		•				

Facility ID#:

0578

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0578</u>
lmnostod	Zono. Longth (novella) to flor	u direction (ft.).	14/: Jah. (fs.).	This	nana (ft).		II-l
Impacted			Width (ft):	I NICKI	ness (ft):		Unknown
		as defined by documentation					
	Alternative meth	nod for determining size of ir	mpacted zone (See source z	one definition attachmen	ts)		
	Map attachment	t					
Monitor V	Vells: Number of relevant r	monitoring wells with ground	lwater data:				None
			Pre-treatment		Post-treatment:		
	Number of wells rela	tive to treatment zone:			_		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	· <u></u>	Upgradient:	Downgradient:		ssgradient:	
			<u></u>	g			
x Soil Boring	gs: Number of relevant so	oil borings with pre-treatmer	nt data: 8				
	Number of relevant so	oil borings with post-treatme	nt data:				
	Number inside treatm	ent zone:	Number outsid	de treatment zone:			
x Types of C	Contaminants						
- "							
				Average Pre-treatme Chen			ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	x Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel	x Total SVOC/VOC	None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
		<u></u>		None	None	None	None
		<u> </u>		None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	The average total:	SVOC/VOC concentration	n in pre-treatment sample: Estimated D	None None None	None None None oost-treatment avera	None None None	None None None
Attachmer	nts:						

Hydr	ogeologic Conceptual	Model		Faci	lity ID#:	0578
<u>x</u>	ogeologic Conceptual l	Model Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated Sediments and impermeable to the Largely permeable sediments with inter-bed to Largely impermeable sediments with inter-bed to Largely impermeable sediments with inter-bed to Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated impermeable to Largely permeable sediments with inter-bed to Largely permeable sediments with inter-bed to the consolidated sediments with the consolidated sediments	consolidated sediments unconsolidated sedimer ledded lenses of lower per edded layers of higher palline rock) consolidated sediments unconsolidated sedimer	nts meability material permeability mater	rial
<u>×</u>	Ground surface eleva Aquifer Characteristic Is more than 1 aquifer	s:	Largely impermeable sediments with inter-be Competent, but fractured bedrock (i.e. crysta Weathered bedrock, limestone, sandstone adjacent to treatment zone: No Yes (number):	alline rock) ft amsl	ermeability mater <u>X</u> Unknown (assume single aquil	
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2	Aquifer 3		
	Flow direction Horizontal hydraulic g	radient (feet/foot):			Unknown	
	Vertical hydraulic grad	dient (feet/foot):			Unknown	
	K range (ft/day) Transmissivity (ft2/day	Measured low high y): Measured low high			d data Unknown d data Unknown	

Comments:

Attachments:

The	rmal Treatment - D	Design							Facility ID#:	<u>0578</u>
<u>x</u>	Thermal treatme	nt:	_ Conductive							
		<u>x</u>	Electrical R	esistance						
			<u>x</u>	3 phase		6 phase		AC power	DC	power
			_ Steam							
				Steam		_ Steam + air		Steam + O2		
			_ Other (descr							
<u>X</u>	Type of Test:	_	t test	Full-s	•					
<u>X</u>	Geology of Treat	tment Zone:		-	_	ous and permea				
				•	•	ous and imperm				ale ille a sanata si al
						ediments with int			•	•
			<u>x</u>					-	s or nigher pen	meability material
				•		ured bedrock (i.e limestone, sands	•	iiile lock)		
	_ Treatment Targe	Zone:	Saturated of		Vade			Roth (Satura	nted and Vadose	zones)
<u>x</u>	Start of Thermal	·	Oaturated (1/2004	orny	vau	Duration:			ned and vadose	, Zones)
^	_ Hydraulic Contro		_ Yes	No		Daration.	<u>157 u</u>			
	,									
<u>x</u>	Treatment Cell D	Design:								
	Size of target zo	ne (ft2):			2500			Unkno	own (40 x 40 ft)
	Thickness of targ	get zone (ft):			<u>16</u>			Unkno	own	
	Depth to top of to	arget zone (ft bo	gs):		<u>10</u>			Unkno	own	
	Thickness of targ	get zone below	water table (f	t):				Unkno	own	
	Number of energ	y delivery point	ts:		9			Unkno	own	
	Number of extra	ction points:			4			Unkno	own	
<u>x</u>	Temperature Pro	ofile:								
	Initial formation t	emperature (de	eg C):						Unknow	n
	Maximum repres	entative format	ion temperate	ure (deg C)	:	<u>90</u>			Unknow	n
	Time to reach m	aximum represe	entative temp	erature (da	ys):	<u>64</u>			Unknow	n
	Duration of treat	ment at represe	ntative tempe	erature (day	/s):	<u>73</u>			Unknow	n
						<u>Dat</u>	<u>te</u>		Temperatu	ıre (deg C)
	Formation temper	erature immedia	itely post-trea	atment:						
	Formation temper	erature post-trea	atment monito	oring event	1:					
	Duration of post-	treatment moni	toring (days):							
<u>x</u>	Mass of contami	nant removed:								
		Via liquid	pumping:					lb	kg	Unknown
		In vapor s	stream:					lb	kg	Unknown
		Total:			4629	.2	<u>x</u>	lb	kg	Unknown
	Comments:	Treated 2200	yd3							
		Spacing of 19	5 ft							
	Attachments:									

Cos	t and Performance					Facility ID#:	<u>0578</u>
<u>x</u>	Performance						
_	Remediation Goal:						
	<u>x</u>	In Groundwater:	T-t-I DALI ODI D 400	// NI==b4b=l==	500// Db-	0 #: 0	N -4-1
			Total PAH SPLP = <100		<u><500 ug/L Pne pounds</u>	enol, < 2 times 2	L std for all other
	<u>x</u>	In Soil:					
				Total PAH =	800 mg/kg		
	Was the Remediatio	n Goal Achieved:					
	<u>x</u>	In Groundwater					
		Comment:					
		<u> </u>	<u>No</u>				
	<u>x</u>	In Soil					
	_	Comment:					
		<u> </u>	<u>No</u>				
	General comments of	on the thermal applic	cation:				
	·						
	Lessons Learned						
	Problems asso	ciated with visous N	IAPL clogging system				
	<u> </u>	olatoa Willi Hoodo I	<u>_ o.oggg oyo.o</u>				
<u>x</u>	Energy						
	Total Energy Used:	26948	1.77	<u>x</u> kWhr	kWhr/m ³	kW	hr/yd³
	<u>x</u> Tot	al energy applied to	treatment zone:	<u>310</u>		_ kWhr/m ³	<u>x</u> kWhr/yd ³
	Oth	er energy:				_ kWhr/m ³	kWhr/yd ³
		Please	e note other energy:				
<u>X</u>	Cost						
	Total Project Cost:		<u>500000</u>				
		nsultant Cost:					
	_	ermal Vendor Cost:	<u>160000</u>		3	.3	
		ergy Cost:		r	n ³	_ yd³	
		er Cost 1:					
	Oth	er Cost 2:					
		er Cost 3:					
	Please note of	her cost:	Other Cost 1:				
		-	Other Cost 2:				

____ Other Cost 3:

File Analyzed By: PD ____ Date: 9/28/2006 Type of treatment: Conductive ___ Steam X ERH ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: _ Pilot Test Full Scale System Start of Test: 10/3/2001 End of Test: <u>7/8/2002</u> Duration: 279 d Type of Site: X Non-DOD _ DoD Facility Name: Charleston Naval Complex Address: City, State, Zip Code: South Carolina OU# or Site #: AOC 607 in zone F Primary point of contact: **David Scaturo** Organization: SC Dept. of Health and Environmental Control Address: City, State, Zip Code: Phone #: 803-896-4185 email: scaturdm@dhec.sc.gov Other contacts or vendors who worked on site _None Point of contact: Dean Williamson Type: <u>X</u> Vendor, Consultant ____ Vendor, Technical Applications __Other Organization: CH2M Hill Address: City, State, Zip Code: Phone #: 352-335-5877, ext 52280 email: dean.williamson@ch2m.com QA/QC Characteristics of Interest Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data Good temperature profile vs. time information Flux assessment Groundwater elevations Geologic cross-section <u>X</u> Hydraulic Conductivity information

Facility ID#:

0580

General Site Information

X Impacted	Impacted zone a	as defined by documentation od for determining size of im			ness (ft):		Unknown
X Monitor V		nonitoring wells with groundy	vater data: Pre-treatment:	<u>28</u>	Post-treatment:	43	None
	Number of wells relat	tive to treatment zone:					
	Pre-treatment	In: 14	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In: 12	Upgradient:	Downgradient:	Cros	ssgradient:	
		_		-			
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:				
	-	oil borings with post-treatmen					
	Number inside treatme	• •		e treatment zone:			
							
X Types of C	Contaminants						
<u></u> .,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	on the state of th			Average Pre-treatme	ent Concentration per		nent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	X Trichloroethene	Hexane	Creosote	1 mg/L	None	0.1 mg/L	None
	X Tetrachloroethene	Jet Fuel		5 mg/L	None	1 mg/L	None
<u>x</u> <u>x</u> <u>x</u>		Napthalene		0.001 mg/L	None	0.01 mg/L	None
		Benzene		0.5 mg/L	None	1 mg/L	None
		Tolune		0.005 mg/L	None	0.01 mg/L	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
		·					
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	X Vinyl Chloride			0.001 mg/L	None	0.1 mg/L	None
	X 1,2-DCE total			None	None	1 mg/L	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	nts:						
Attachmer	nts:						

Facility ID#:

0580

General Site Assessment Data

<u>X</u>	Geology:	Zone	Unconsolida	ted Sediments				
		Vadose Zone:	Relative	ely homogeneo	us and permeab	le unconsolidated se	ediments	
			Relative	ely homogeneo	us and imperme	able unconsolidated	sediments	
			Largely	permeable sec	liments with inte	r-bedded lenses of I	ower permeabi	lity material
			X Largely	impermeable s	ediments with in	nter-bedded layers o	f higher perme	ability material
			Compe	tent, but fractur	ed bedrock (i.e.	crystalline rock)		
			Weathe	ered bedrock, lir	nestone, sandst	one		
		Saturated Zone:	Relative	ely homogeneo	us and permeab	le unconsolidated se	ediments	
			Relative	ely homogeneo	us and imperme	able unconsolidated	sediments	
			X Largely	permeable sec	liments with inte	r-bedded lenses of I	ower permeabi	lity material
			Largely	impermeable s	ediments with in	nter-bedded layers o	f higher perme	ability material
			Compe	tent, but fractur	ed bedrock (i.e.	crystalline rock)		
			Weathe	ered bedrock, lir	nestone, sandst	cone		
<u>X</u>	Ground surface eleva	ation based on wells in	or adjacent to t	reatment zone:	<u>~8</u>	ft amsl		_ Unknown
<u>X</u>	Aquifer Characteristic	os:						
	Is more than 1 aquife	er present?	_ NoX	Yes (numl	per):	t	Jnknown (assum	e single aquifer)
			Aquifer 1		Aquifer 2	Aquifer 3		
	Depth to water:	low value (ft bgs):	<u>2</u>	<u>3</u>		<u>3</u>		
		high value (ft bgs):	<u>4</u>	<u>4</u>		<u>5</u>		
		Unknown:						
<u>X</u>	Flow direction		<u>NE</u>				_	
<u>X</u>	Horizontal hydraulic g	gradient (feet/foot):	0.0107 - 0.013	3		0.0133		Unknown
	Vertical hydraulic gra	dient (feet/foot):	see attachment					Unknown
<u>X</u>	K range (ft/day)	Measured	d using: <u>X</u>	Slug Test	Labo	oratory _	Field data	
		low	0.194	0.45		0.0081		Unknown
		high	1.89	1.25		0.027		
	Transmissivity (ft2/da	ay): Measured	d using:	Slug Test	Labo	oratory _	Field data	
		low					<u>X</u>	Unknown
		high					_	
	Comments							
	Comments:							
	CIA	/ velocities average 0	01 ft/day	Vortical perm	oability in clay	unit (bottom) is 0.0	13 ft/day	
	<u>Gw</u>	<u>r volucilies avelage u</u>	.v i ivuay.	v citical pelli	capility III Glay	unit (Dottolli) 15 U.U	o ivaay	

Facility ID#:

0580

see attachment AOC607.doc

Attachments:

Hydrogeologic Conceptual Model

The	rmal Treatment - I	Design										Facil	ity ID#:	0580	
<u>X</u>	Thermal treatme	ent:		Cond	uctiv	e									
			X	Elect	rical l	Resistance									
				_ Stean	<u>X</u>	3 phase		6 pha	se		AC powe	er	DC	power	
		•		_ Steam		Steam		Steam	ı + air		Steam +	O2			
				Other	(des	cribe)									
<u>X</u>	Type of Test:	1	Pilot	test		X Ful	l-scale S	ystem							
<u>X</u>	Geology of Treatment Zone: Relatively						y homo	geneous an	d permeal	ble und	consolida	ted sedi	ments		
						_ Relativel	y homo	geneous an	d imperme	eable ι	unconsoli	dated se	ediments		
					<u>X</u>	Largely p	permeab	le sedimen	ts with inte	er-bed	ded lense	s of low	er perme	ability m	naterial
						_ Largely i	mperme	able sedim	ents with i	nter-be	edded lay	ers of h	igher peri	neability	y material
					_	_ Compete	mpetent, but fractured bedrock (i.e. crystalline rock)								
					_	_ Weather	ed bedro	ock, limesto	ne, sands	tone					
<u>X</u>	Treatment Targe	e Zone:		Satu	rated	lonly		Vadose only		<u>X</u>		turated a	nd Vadose	zones)	
<u>X</u>	Start of Thermal	Test:	10/3/	2001					Duration:	278 c	<u>l</u>				
<u>X</u>	Hydraulic Contro	ol .	<u>X</u>	Yes		No									
<u>x</u>	Treatment Cell [Design:													
	Size of target zo	ne (ft2):					<u>16525</u>				Unknown (<u>150</u> x <u>150</u> ft)			<u>150</u> ft)	
	Thickness of tar	get zone (ft):					<u>12</u>			Unknown					
	Depth to top of t	arget zone (f	ft bg	s):			<u>4</u>	<u>4</u>			Un	Unknown			
	Thickness of tar	get zone bel	ow v	vater t	able	(ft):	<u>10</u>				Unknown				
	Number of energ	gy delivery p	oints	S:			<u>107</u>				Unknown				
	Number of extraction points:						<u>97</u>				Un	known			
<u>x</u>	Temperature Pro	ofile:													
	Initial formation	temperature	(de	g C):				<u>26</u>					Unknow	ı	
	Maximum repres	sentative for	mati	on tem	npera	ture (deg	C):): <u>95</u>					Unknow	ı	
	Time to reach m	aximum rep	rese	ntative	e tem	perature (e (days): <u>163</u>						Unknow	ı	
	Duration of treatment at representative temperature (da							<u>114</u>					Unknow	1	
									Date	<u>e</u>		<u>T</u>	emperatu	re (deg	<u>C)</u>
	Formation tempor	erature imme	ediat	ely po	st-tre	eatment:									
	Formation tempor	ormation temperature post-treatment monitoring event							<u>3</u>			<u>35.6</u>			
	Duration of post	-treatment m	onit	oring (days	s):									
<u>X</u>	Mass of contam	inant remove	ed:												
	Via liquid pumping:										lb		kg		Unknown
	In vapor stream:										_lb		kg		Unknown
		Total:						481.5		<u>X</u>	lb		_kg		Unknown
	Comments:														
	6 months post treatment monitoring dechlorination pilot study was performance.										nonths b 310 3/4				ft and
	244 to 10 ft; 12 8" steel piles; 6 geoprobe									usea	310 3/4	ground	<u>u 1005, 6</u>	<u>0 10 12</u>	it aliù
	Attachments:														

Cost and Performance Facility ID#: 0580 Performance Remediation Goal: In Groundwater: 1) 95% reduction of total chlorinated solvents in GW concentration in treatment zone; 2) Achieve 90% reduction of the total summation of chlorinated solvents in each shallow well in the treatment zone. In Soil: Was the Remediation Goal Achieved: X In Groundwater Comment: _ In Soil Comment: General comments on the thermal application: 1) Power cycled on 50 minutes and off 10 minutes to allow "re-wetting" of electrodes and to prevent area immediately around electrods from drying out; 2) Last 2 months 23 electrodes, 5 sheet piles, 70 ground rods, and 6 geoprobe electrodes were not used because they reduce to 1 power unit; 3) 14' spacing originally then went to 7 ft using ground rods. Lessons Learned Energy _ kWhr/yd³ Total Energy Used: ___ kWhr/m³ kWhr kWhr/yd3 _ Total energy applied to treatment zone: _ Other energy: kWhr/m³ kWhr/yd³ _ Please note other energy: <u>X</u> Cost Total Project Cost: 1,274,000 total ____ Consultant Cost: __ Thermal Vendor Cost: __ Energy Cost: X Other Cost 1: 50,000 ___ Other Cost 2: ____ Other Cost 3:

Other Cost 1:

Other Cost 2:
Other Cost 3:

monitoring

Please note other cost:

General Site Information Facility ID#: 0582 PD ____ File Analyzed By: Date: 10/26/2006 Type of treatment: Conductive ____ Steam <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: _Pilot Test Full Scale System Start of Test: 2/1/2005 End of Test: 11/1/2005 Duration: 9 months Type of Site: Non-DOD __ DoD Facility Name: Camlot Dry Cleaners Address: City, State, Zip Code: Fargo, ND OU# or Site #: Primary point of contact: Joyce Ackerman Organization: Address: City, State, Zip Code: Phone #: 303-312-6822 email: ackerman.joyce@epa.gov Other contacts or vendors who worked on site _ None Point of contact: Gwen Christiansen Type: ___ Vendor, Consultant _____ Vendor, Technical Applications __Other Organization: **EPA** Address: City, State, Zip Code: Phone #: 303-312-6463 email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment

_ Geologic cross-section

____ Groundwater elevations

___ Hydraulic Conductivity information

General Site As	Facility II	D#: <u>0582</u>										
Impacted	- "	Length (parallel to flow direction)(ft.): Width (ft): Thickness (ft): Impacted zone as defined by documentation										
	 :	•		ne definition attachmer	nts)							
	Map attachment	Alternative method for determining size of impacted zone (See source zone definition attachments) Map attachment										
Monitor V	Vells: Number of relevant m	Number of relevant monitoring wells with groundwater data: Pre-treatment: Post-treatment:										
	Number of wells relat	ive to treatment zone:	Fie-treatment.		Post-treatment:							
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:						
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:						
				ŭ		· —						
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:									
	Number of relevant so	il borings with post-treatmen	nt data:									
	Number inside treatme	ent zone:	_ Number outside	treatment zone:								
Types of 0	Contaminants											
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:					
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)					
	x Trichloroethene	Hexane	Creosote	None	None	None	None					
	x Tetrachloroethene	Jet Fuel		None	None	None	None					
	1,1-dichloroethene	Napthalene		None	None	None	None					
	x cis-1,2-dichloroethene	Benzene		None	None	None	None					
	x trans-1,2-dichloroethene	Tolune		None	None	None	None					
	1,1-dichloroethane	Ethylbenzene		None	None	None	None					
	1,2-dichloroethane	m/p-xylene		None	None	None	None					
	1,1,1-trichloroethane	o-xylene		None	None	None	None					
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None					
	1,1,2,2-tetrachloroethane			None	None	None	None					
	<u>x</u> Vinyl Chloride			None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
_												
Comme	ents:											
				•		•						
Attachmer	nts:											

Hydr	ogeologic Conceptual	Model		Facility ID#:	0582						
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated Sediments								
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sec	diments							
			Relatively homogeneous and impermeable unconsolidated s	sediments							
			Largely permeable sediments with inter-bedded lenses of lov	wer permeability material							
			\underline{x} Largely impermeable sediments with inter-bedded layers of	higher permeability materi	ial						
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated s	nconsolidated sediments							
			Largely permeable sediments with inter-bedded lenses of lovers and the control of the contr	nts with inter-bedded lenses of lower permeability material							
				argely impermeable sediments with inter-bedded layers of higher permeability material							
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
	Ground surface eleva	ation based on wells in o	r adjacent to treatment zone: ft amsl	Unknown							
	-		,								
<u>x</u>	Aquifer Characteristic	cs:									
	Is more than 1 aquife	er present?	No Yes (number): Un	nknown (assume single aquif	er)						
			Aquifer 1 Aquifer 2 Aquifer 3								
	Depth to water:	low value (ft bgs):	<u> </u>								
		high value (ft bgs):	7								
		Unknown:									
	Flow direction										
	_ Horizontal hydraulic	,	·	Unknown							
	Vertical hydraulic gra	adient (feet/foot):		Unknown							
	_K range (ft/day)	Measured .	using: Slug Test Laboratory	Field data							
		low		Unknown							
	Transmissivity (ft2/da	high ay): Measured	using:Slug TestLaboratory	Field data							
	Transmissivity (112/06	low	using Slug rest Laboratory								
		high		CIIKIIOWII							
		riigir									
	Comments:										

Conductivity - 5000 uS/cm

Attachments:

Ther	mal Treatment - Design								Facility ID#:	0582	
<u>x</u>	Thermal treatment:		Conductive	·							
		<u>x</u>	Electrical I	Resistance							
				3 phase		6 phase		AC power	D	C power	
			Steam								
				_ Steam		Steam + air		Steam + C)2		
			Other (des	cribe)							
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Full-	scale System						
<u>x</u>	Geology of Treatment Zone	:		_ Relatively	homogeneo	us and permeal	ble und	consolidate	ed sediments		
		Relat			vely homogeneous and impermeable unconsolidated sediments						
				_ Largely pe	ermeable sed	diments with inte	er-bed	ded lenses	of lower perm	eability material	
			<u>x</u>	Largely in	npermeable s	sediments with i	inter-be	edded laye	ers of higher pe	rmeability material	
				-		ed bedrock (i.e.	-	alline rock)			
			_			mestone, sands	stone				
<u>X</u>	Treatment Targe Zone:		Saturated	only	Vados	-	<u>x</u>		irated and Vados	se zones)	
<u>X</u>	Start of Thermal Test:	2/1/20				Duration:	9 mo	nths			
	_ Hydraulic Control		Yes	No							
.,	Treatment Cell Decign:										
<u>x</u>	Treatment Cell Design:				10200			T I and		(4)	
	Size of target zone (ft2): Thickness of target zone (ft	١.			10300 56			Unk	-	x ft)	
	Depth to top of target zone	,	z)·		0			Unk			
	Thickness of target zone be			(ft)·	<u>u</u>			Unk			
	Number of energy delivery			()-	<u>56</u>			Unk			
	Number of extraction points				_			Unk			
	•										
	Temperature Profile:										
	Initial formation temperature	e (deg	(C):						Unknow	vn	
	Maximum representative fo	rmatic	on tempera	ture (deg C):				Unknow	vn	
	Time to reach maximum re	oreser	ntative tem	perature (da	ays):				Unknow	vn	
	Duration of treatment at rep	resen	tative temp	erature (da	ays):				Unknow	vn	
						<u>Dat</u>	<u>e</u>		Tempera	ture (deg C)	
	Formation temperature imm	nediate	ely post-tre	atment:							
	Formation temperature pos	t-treat	ment moni	toring even	t 1:						
	Duration of post-treatment	monito	oring (days):							
	Mass of contaminant remov										
			oumping:					_ lb	kg	Unknown	
			ream:		£400			_lb	kg	Unknown	
	Tota	l:			5188		<u>X</u>	lb	kg	Unknown	
	Commente										
	Comments:										
	Troated	olum	e of 13800) vd3							
	Attachments:	Jiuiile	UI 13000	, yu <u>o</u>							
	, macrimonts.										

Cos	and Performance				Facility ID#:	0582
<u>x</u>	Performance					
_	Remediation Goal					
	<u>x</u>					
	Δ	iii Giodilawatoi.		Total VOCs of 1	ma/l	
	<u>x</u>	In Soil:		10tal VOC3 01 1 1	ng/L	
	<u> </u>	III 30II.		PCE = 3 mg/kg		
				FCL = 3 Hig/kg		
	Was the Remedia	tion Goal Achieved:				
	<u>x</u>	In Groundwater				
		Comment:				
			<u>yes</u>			
	<u>x</u>	In Soil				
	_	Comment:				
			Yes, except in 1 location	n that previous characterization f designated treatment area.	n indicated the contam	ination extended
	General comments	s on the thermal appl	ication:			
	Lessons Learned					
.,	Factory.					
<u>x</u>	Energy	1-		1337		/I= /
	Total Energy Used				'hr/m ³ kW	
		otal energy applied to	o treatment zone:	2.8 mW-hrs	kWhr/m ³	kWhr/yd ³
	C	other energy:	-		kWhr/m ³	kWhr/yd ³
		Pleas	se note other energy:	-		
	_ Cost					
	_ Cost Total Project Cost:					
		Consultant Cost:				
		hermal Vendor Cost:		3	. 3	
		nergy Cost:		m ³	yd ³	
		other Cost 1:				
	c	Other Cost 2:				
	C	Other Cost 3:				
	Please note	other cost:	Other Cost 1:			
			Other Cost 2:			

____ Other Cost 3:

General Site Information Facility ID#: 0585 File Analyzed By: <u>x</u> PD <u>x</u> Date: 4/11/2005 ____ERH ____ Steam Type of treatment: __Conductive Hot gas _____Pesticides Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating _Other: Treatment Status: Active Post ___ Full Scale System Type of Test: Pilot Test Start of Test: 1992 End of Test: 1992 Duration: 90 hr Type of Site: __ DoD ____Non-DOD Facility Name: Accutech demo Address: City, State, Zip Code: Somerville, NJ OU# or Site #: _ Primary point of contact: <u>EPA 540/AR-93?509 July 1993</u> Organization: Address: City, State, Zip Code: Phone #: email: ____ Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____Other Organization: ___ Address: _ City, State, Zip Code: Phone #: ___ email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data

__ Flux assessment

____ Geologic cross-section

____ Good temperature profile vs. time information

___ Hydraulic Conductivity information

____ Groundwater elevations

G	eneral Site As	sessment Data						Facility II	D#: <u>0585</u>
_	Impacted	- "		v direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
		Alte		od for determining size of im	npacted zone (See source zo	one definition attachmer	ats)		
_	Monitor V	Vells: Number	of relevant m	nonitoring wells with ground					None
		Number	of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
		Pr	e-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Po	st-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
_	Soil Boring	gs: Number of	of relevant so	il borings with pre-treatment	t data:				
		Number of	of relevant so	il borings with post-treatmer	nt data:				
		Number i	nside treatme	ent zone:	Number outside	e treatment zone:			
x	Types of C	Contaminants							
						Average Pre-treatme	ent Concentration per	Average Post-treatme	ent Concentration per
		Chlorinated So	lvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		x Trichloroethene		Hexane	Creosote	10 mg/L	None	None	None
		x Tetrachloroether	ne	Jet Fuel		1 mg/L	None	None	None
		1,1-dichloroethe	ne	Napthalene		None	None	None	None
		cis-1,2-dichloroo	ethene	Benzene		None	None	None	None
		trans-1,2-dichlor		Tolune		None	None	None	None
		1,1-dichloroetha		Ethylbenzene		None	None	None	None
		1.2-dichloroetha		m/p-xylene		None	None	None	None
		1,1,1-trichloroet		o-xylene		None	None	None	None
(Chemicals of Concern	1,1,2-trichloroet				None	None	None	None
	Concern	1,1,2,2-tetrachlo				None	None	None	None
		Vinyl Chloride				None	None	None	None
		x DCE				1 mg/L	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
_		-	<u> </u>	, 	·	,			
	Comme	nts:							
		-							_
					-				
	Attachmen	nts:							
				•					

Hyd	rogeologic Conceptual	Model		Facility ID#: 0585
x	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ed sediments f lower permeability material of higher permeability material sediments ed sediments f lower permeability material
<u>x</u>	Ground surface eleva	ation based on wells in o	or adjacent to treatment zone: ft amsl	<u>x</u> Unknown
<u>x</u>	Aquifer Characteristic	os:		
_	Is more than 1 aquife	r present?	No Yes (number): x	Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3	
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	21 25	_ _ _
_	_ Flow direction			_
X	Horizontal hydraulic g Vertical hydraulic gra			<u>X</u> Unknown <u>X</u> Unknown
X	K range (ft/day) Transmissivity (ft2/da	Measured low high ny): Measured		Field data X Unknown Field data
		low high		<u>X</u> Unknown

Comments:

The	rmal Treatment - Design			Facility	y ID#: <u>0585</u>
<u>x</u>	Thermal treatment:	Conductive			
		Electrical Resistance			
		3 phase	6 phase	AC power	DC power
		Steam			
		Steam	Steam + air	Steam + O2	
		X Other (describe)	hot gas		
<u>x</u>	Type of Test: <u>x</u>	Pilot test Ful	ll-scale System		
<u>x</u>	Geology of Treatment Zone	: Relativel	ly homogeneous and permea	able unconsolidated sedim	ents
			ly homogeneous and imperm		
			permeable sediments with int		•
			impermeable sediments with		her permeability material
			ent, but fractured bedrock (i.e		
	Treatment Torge Zone:		red bedrock, limestone, sands		Woden mane)
_	_Treatment Targe Zone: Start of Thermal Test:	Saturated only	vadose only Duration:	Both (Saturated and	i vadose zones)
<u>X</u>	Hydraulic Control	<u>X</u> YesNo		. <u>90 iiis</u>	
<u>x</u>	Trydradiic Control	<u>x</u> 103100			
<u>x</u>	Treatment Cell Design:				
_	Size of target zone (ft2):			<u>x</u> Unknown	(x ft)
	Thickness of target zone (ft	i):		<u>x</u> Unknown	
	Depth to top of target zone	(ft bgs):		<u>x</u> Unknown	
	Thickness of target zone be	elow water table (ft):		<u>x</u> Unknown	
	Number of energy delivery	points:	<u>1</u>	Unknown	
	Number of extraction points	s:	<u>2</u>	Unknown	
<u>x</u>	Temperature Profile:				
_	Initial formation temperature	e (deg C):		<u>x</u> t	Unknown
	Maximum representative fo	rmation temperature (deg	C):	<u>x</u>	Unknown
	Time to reach maximum re	presentative temperature (days):	<u>x</u> [Unknown
	Duration of treatment at rep	oresentative temperature (d	days):	<u>x</u>	Unknown
	Formation tomporature imp	andiataly part transments	<u>Da</u>	<u>te</u> <u>Te</u>	mperature (deg C)
	Formation temperature imn Formation temperature pos		nt 1·		
	Duration of post-treatment	· ·	<u>-</u>		
	burdion of poor troutmone	morning (dayo).			
<u>x</u>	Mass of contaminant remov	ved:			
	Via I	iquid pumping:		lb l	kg <u>x</u> Unknown
	In va	apor stream:		lb l	kg <u>X</u> Unknown
	Tota	l:		lb l	cg <u>x</u> Unknown
	Comments:				
	Attachments:				

t and Performance				Facility ID#:	<u>0585</u>
_ Performance					
Remediation Goal:					
In Ground					
In Soil:					
Was the Remediation Goal Achie					
In Ground	dwater				
Con	nment:				
In Soil					
Con	nment:				
General comments on the therm	nal application:				
Lessons Learned					
Energy					
Total Energy Used:		kWhr	kWhr/m ³	kV	Vhr/yd ³
Total energy ap	oplied to treatment zone:			_ kWhr/m ³	kWhr/y
Other energy:	_			_ kWhr/m³	kWhr/y
<u> </u>	_ Please note other energy:				
Cost					
Total Project Cost:					
Consultant Cos	et:				
Thermal Vendo	or Cost:				
Energy Cost:			m ³	_ yd³	
Other Cost 1:					
Other Cost 2:					
					
Other Cost 3:					
Other Cost 3: Please note other cost:	Other Cost 1:				

Other Cost 3:

File Analyzed By: PD ____ Date: 9/13/2006 ERH Type of treatment: Conductive Steam Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: End of Test: _____ Duration: 100 hrs 2001 Type of Site: ____Non-DOD __ DoD Facility Name: Northern NJ Address: City, State, Zip Code: OU# or Site #: Paper by Denis M. Conley, et al Primary point of contact: Organization: Haley & Aldrich Address: 200 town Centre Drive, Suite 2 City, State, Zip Code: Rochester, NY 14623 Phone #: <u>585-359-9000</u> email: dconley@haleyaldrich.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0587

General Site Information

___ Hydraulic Conductivity information

<u>x</u> Impacted		v direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u> Unknown
		od for determining size of im	nacted zone (See source z	ana definition attachmen	to)		
	Map attachment	od for determining size or in	pacieu zone (See source z	one delimilion allacimer	115)		
	wap attacriment						
x Monitor V	Valle: Number of relevant m	nonitoring wells with groundw	vater data:				x None
x Monitor V	veils. Number of relevant if	ionitoring wens with groundw		:	Post-treatment:		<u>x</u> None
	Number of wells relat	ive to treatment zone:	ric tication.	· 	Tost treatment.		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				· · · · g · - · · · · ·			
Soil Boring	s: Number of relevant so	il borings with pre-treatment	data:				
		il borings with post-treatmen					
	Number inside treatme			le treatment zone:			
			-				
x Types of C	Contaminants						
				Average Pre-treatme	ent Concentration per		nent Concentration per mical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	x Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	x cis-1,2-dichloroethene	Benzene		None	None	None	None
	x trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane	x hydrocarbons		None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
	x methylene chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	nts:						
Attachmen	nts:						

0587

General Site Assessment Data

Hyd	rogeologic Conceptua	Model		Facility ID#: 0587
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated States Largely permeable sediments with inter-bedded lenses of I Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated States Largely permeable sediments with inter-bedded lenses of I Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments ower permeability material f higher permeability material ediments sediments ower permeability material
<u>x</u>	Ground surface elev	ation based on wells in c	r adjacent to treatment zone: ft amsl	<u>x</u> Unknown
X	Aquifer Characteristi Is more than 1 aquife Depth to water:		No Yes (number): U Aquifer 1 Aquifer 2 Aquifer 3 3	Jnknown (assume single aquifer) —
	_ Flow direction	Unknown:		_
<u>x</u>	Horizontal hydraulic Vertical hydraulic gra	, ,		<u>x</u> Unknown <u>x</u> Unknown
<u>x</u>	K range (ft/day)	Measured low high	Slug TestLaboratory	Field data Unknown
	Transmissivity (ft2/da	9	using:Slug TestLaboratory	Field data <u>X</u> Unknown
	Comments:			

DTW had dropped to 10 feet (from 7 ft) within 24 hours of multi-phase extraction (MPE) only wells being on confining layer K=4.5(10^-6)cm/sec

Treatment Zone (upper) K=10 -3 cm/sec

The	rmal Treatment - Design					Facility ID#:	0587	
<u>x</u>	Thermal treatment:	x Conductive						
		Electrical Resistance						
		3 phase		_ 6 phase	AC power	DC	power	
		Steam		_ Steam + air	Steam + O2)		
		Other (describe)		_ Steam + an	Steam + O2	-		
<u>x</u>	Type of Test: <u>x</u>		-scale Syster	n				
<u>x</u>	Geology of Treatment Zone			·· eous and permeat	ole unconsolidated	d sediments		
^	Coology of Trouthork Zone		_	eous and imperme				
			_	ediments with inte			ability ma	terial
				sediments with in		•	-	
				ured bedrock (i.e.		0 1	,	
				limestone, sands				
<u>x</u>	Treatment Targe Zone:	Saturated only		ose only	Both (Satur	ated and Vadose	zones)	
<u>x</u>	Start of Thermal Test:	2001		Duration:	~100 hours (~4 da	ays)		
<u>x</u>	Hydraulic Control	<u>x</u> YesNo						
<u>x</u>	Treatment Cell Design:							
	Size of target zone (ft2):		<u>481</u>		Unkn	nown (х _	ft)
	Thickness of target zone (ft	i):			<u>x</u> Unkn	nown		
	Depth to top of target zone	(ft bgs):	-		<u>x</u> Unkn	nown		
	Thickness of target zone be	elow water table (ft):			<u>x</u> Unkn	nown		
	Number of energy delivery	points:	<u>3</u>		Unkn	nown		
	Number of extraction points	3:	1		Unkn	nown		
	_Temperature Profile:							
	Initial formation temperature	e (deg C):		<u>10</u>		Unknown	į.	
	Maximum representative fo	rmation temperature (deg C	C):	<u>88</u>		Unknown	i	
	Time to reach maximum re	presentative temperature (d	lays):	1		Unknown		
	Duration of treatment at rep	oresentative temperature (da	ays):	<u>~3</u>		Unknown		
	Formation temperature imm	nediately post-treatment:		<u>Date</u>	<u> </u>	<u>Temperatu</u>	e (deg C	1
	Formation temperature pos		nt 1:					_
	Duration of post-treatment	· ·					_	
<u>x</u>	Mass of contaminant remov	ved:						
	Via I	iquid pumping:			lb	kg	<u>x</u>	Unknown
	In va	apor stream:			lb	kg	<u>x</u>	Unknown
	Tota	.l:			lb	kg	<u>x</u>	Unknown
	Comments:							
	Spacing of	of 6ft on heaters and 3.5 f	ft from MPI	<u> E Well</u>				
	Attachments:							

Cost and Performance Facility ID#: 0587

Remediation 0							
	∍oal:						
	In Groun	dwater: ——					
	x In Soil:						ne rate of energy undersall
		Hecessal		control system; 4			necessary nyuraun
Was the Reme	ediation Goal Ach						
	In Groun	dwater					
	Cor	mment:					
	In Soil						
	Cor	mment:					
General comm	nents on the thern	nal annlication	ı.				
———	ients on the them	пагаррпсаног					
						2	
Total Energy (kWhr/m		
Total Energy L	Jsed: Total energy a	pplied to treat	ment zone:	kWhr		kWhr/m ³	kWhr/y
Total Energy L		pplied to treat	ment zone:				kWhr/y
Total Energy L	Total energy a		ment zone:			kWhr/m ³	kWhr/y
Total Energy L	Total energy a		_			kWhr/m ³	kWhr/y
Total Energy L	Total energy a Other energy:		_			kWhr/m ³	kWhr/y
Total Energy L Cost	Total energy a Other energy: Cost:	_ Please note	_			kWhr/m ³	kWhr/y
Total Energy L	Total energy a Other energy: Cost: Consultant Co	_ Please note	_			kWhr/m ³	kWhr/y
Total Energy L Cost	Total energy a Other energy: Cost: Consultant Cost Thermal Vendo	_ Please note	_			kWhr/m ³ kWhr/m ³	kWhr/y
Total Energy L	Total energy a Other energy: Cost: Consultant Co: Thermal Vendo Energy Cost:	_ Please note	_			kWhr/m ³	kWhr/y
Total Energy L Cost Total Project C	Total energy a Other energy: Cost: Consultant Co: Thermal Vende Energy Cost: Other Cost 1:	_ Please note	_			kWhr/m ³ kWhr/m ³	kWhr/y
Total Energy L Cost Total Project C	Total energy a Other energy: Cost: Consultant Co: Thermal Vendo Energy Cost:	_ Please note	_			kWhr/m ³ kWhr/m ³	kWhr/y
Total Energy L Cost Total Project C	Total energy a Other energy: Cost: Consultant Co: Thermal Vende Energy Cost: Other Cost 1:	_ Please note	_			kWhr/m ³ kWhr/m ³	kWhr/yd ³ kWhr/yd kWhr/yd
Total Energy L Cost Total Project C	Total energy a Other energy: Cost: Consultant Co: Thermal Vende Energy Cost: Other Cost 1: Other Cost 2:	Please note	_			kWhr/m ³ kWhr/m ³	kWhr/ye
Cost Total Project C	Cost: Consultant Cost Thermal Vendo Energy Cost: Other Cost 1: Other Cost 3:	Please note	e other energy:			kWhr/m ³ kWhr/m ³	kWhr/ye

<u>x</u>	File Analyzed By: JT	<u>x</u>	PD					Date:	10/30/2006
	Type of treatment:		Conductive	_ Steam	<u>x</u>	ERH	Other:		
	Type of Contaminant:	<u>x</u>	Chlorinated Solvents		Petr	oleum Hydroc	arbons	Pesticide	s
			_Wood Treating		Oth	er:			
	Treatment Status:		_Active	Post					
	Type of Test:		Pilot Test	_ Full Scale	e Syste	m			
	Start of Test:			End	of Tes	t:		Duration:	
	Type of Site:		Non-DOD	_ DoD					
<u>x</u>	Facility Name: Paterson, 1	ŊJ							
	Address:								
	City, State, Zip Code:	Pate	erson, NJ						
	OU# or Site #:								
	Drimow, point of contact	Doz	id Flaming						
<u> </u>	Primary point of contact:	Dav	rid Fleming						
	Organization: <u>TRS</u> Address: 7421-A Warren	CE.							
	<u></u>								
	City, State, Zip Code:	Sno	qualmie, WA 98065						
	Phone #: 425-396-4266			emaii: die	<u>eming@</u>	thermalrs.com			
<u>x</u>	Other contacts or vendors wh	no wo	rked on site			_ None			
	Point of contact: Mari	k Bov	<u>ven</u>						
	Type: <u>x</u> Vendor, C	onsul	tantVen	dor, Techni	ical Ap	plications	Oth	ner	
	Organization: Anderson	Mulh	olland						
	Address:								
	City, State, Zip Code:								
	Phone #: 914-251-0400 x3	<u>307</u>		email: mb	owen@	amaiconsult.c	om		
O	A/QC								
۷.	r., QO								
	_ Characteristics of Interest								
	Good pre- and post-tre	atmer	nt groundwater data			_ Good pre- ar	nd post-treatme	nt soil data	
	Good temperature prof	ile vs	. time information		_	_ Flux assessn	nent		
	Groundwater elevation					Geologic cro	oss-section		
	Hydraulic Conductivit	y info	rmation						

0593

General Site Information

General Site A	ssessment Data					Facility II	D#: <u>0593</u>
Impacted	5 ".		Width (ft):	Thick	ness (ft):		Unknown
		is defined by documentation					
		=	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor	Wells: Number of relevant m	nonitoring wells with groundy					None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin		il borings with pre-treatment					
		il borings with post-treatmen					
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Tunas of	Contominanto						
Types of	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	<u>x</u> Tetrachloroethene	Jet Fuel		50 mg/L	100 mg/kg	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comm	ante:						
Commo							
Attachme	nts:						
							-

Hydrogeologic Co	onceptual Model						Facility ID#:	0593				
Geology:	Zon	<u>e</u>	Unconsolidated S	ediments_								
	Vadose Z	ione:	Relatively ho	mogeneous and	permeable unc	onsolidated sedi	ments					
			Relatively ho	mogeneous and	impermeable u	nconsolidated se	ediments					
			Largely permeable sediments with inter-bedded lenses of lower permeability material									
			Largely impermeable sediments with inter-bedded layers of higher permeability material									
			Competent, but fractured bedrock (i.e. crystalline rock)									
			Weathered bedrock, limestone, sandstone									
	Saturated	Zone:	Relatively homogeneous and permeable unconsolidated sediments									
		•	Relatively ho	mogeneous and	impermeable u	nconsolidated se	ediments					
			Largely perm	neable sediments	with inter-bedo	ed lenses of low	er permeability mate	erial				
			Largely impe	rmeable sedime	nts with inter-be	dded layers of hi	igher permeability m	naterial				
			Competent, I	out fractured bed	Irock (i.e. crysta	lline rock)						
			Weathered b	edrock, limeston	e, sandstone							
Ground sur	face elevation based	on wells in or	adjacent to treatm	ent zone:		ft amsl	Unkno	wn				
Aquifer Cha	aracteristics:											
Is more tha	n 1 aquifer present?	1	No	Yes (number):		Unk	nown (assume single	aquifer)				
			Aquifer 1	Aquif	er 2	Aquifer 3						
Depth to wa	ater: low value	(ft bgs):										
	high value	e (ft bgs):										
	Unknown	: .										
Flow directi	on	-										
Horizontal I	nydraulic gradient (fee	et/foot):					Unkno	wn				
Vertical hyd	draulic gradient (feet/f	oot):					Unkno	wn				
K range (ft/	day)	Measured u	sing: S	Slug Test	Laboratory		_ Field data					
		low					Unkno	wn				
		high _		-								
Transmissi	vity (ft2/day):	Measured u	sing: S	Slug Test _	Laboratory	_	_ Field data					
		low					Unkno	wn				
		high _										
	-											
Comments:	·											
					_							
Attachment	s:											
	-											

The	rmal Treatment - Design							Fa	cility ID#:	<u>0593</u>
<u>x</u>	Thermal treatment:		_ Conductive	e						
		<u>x</u>	Electrical I	Resistance						
				_ 3 phase	_	6 phase		AC power	DC	power
			_ Steam	Steam	_	Steam + air	\$	Steam + O2		
			Other (desc	cribe)						
	Type of Test:	_ Pilot	test	Full-	scale Syst	em				
	_ Geology of Treatment Zon	e:		_ Relatively	homoge	neous and perme	eable unco	nsolidated se	ediments	
				_ Relatively	homoge	neous and imper	meable un	consolidated	sediments	
				_ Largely pe	ermeable	sediments with i	inter-bedde	ed lenses of lo	ower perme	ability material
				_ Largely im	permeat	le sediments wit	th inter-bed	ded layers of	f higher perr	neability material
				_ Competer	nt, but fra	ctured bedrock (i	i.e. crystall	ine rock)		
				_ Weathere	d bedroc	k, limestone, san	dstone			
	_ Treatment Targe Zone:		_ Saturated	only	V	-		Both (Saturated		
	_ Start of Thermal Test:					Duratio	on:			
	_ Hydraulic Control		_ Yes	No						
	Tractor ant Call Design.									
	_ Treatment Cell Design:							11.1		- 60
	Size of target zone (ft2):	F#\.						Unknow	-	_ x ft)
	Thickness of target zone (find the content of the content of target zone)		10/.					Unknow		
	Thickness of target zone b			(ft)·				Unknow		
	Number of energy delivery			(11).				Unknow		
	Number of extraction point	-	J.					Unknow		
	realiser of extraction point							Chknow		
	_ Temperature Profile:									
	Initial formation temperatu	re (de	g C):						Unknowr	1
	Maximum representative for			ture (deg C):				Unknowr	
	Time to reach maximum re		•						Unknowr	ı
	Duration of treatment at re	-							Unknowr	ı
					• /					
						<u>D</u>	<u>Date</u>		Temperatu	re (deg C)
	Formation temperature im-	media	tely post-tre	atment:						
	Formation temperature po-	st-trea	tment moni	toring event	t 1 :					
	Duration of post-treatment	monit	oring (days):						
	_ Mass of contaminant remo	ved:								
	Via	liquid	pumping:				1	b	kg	Unknown
	In v	apor s	tream:				1	b	kg	Unknown
	Tota	al:					1	b	kg	Unknown
	Comments:									
	Attachments:									

and Performance					Facility ID#:	<u>0593</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_	·					
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Whr/yd ³
To	tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yo
	her energy:				_ kWhr/m ³	kWhr/yo
		note other energy:				
	110000	note enter energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
Th	ermal Vendor Cost:					
En	ergy Cost:			m³	_ yd³	
	her Cost 1:					
	her Cost 2:					
	her Cost 3:					
Oil		Other Cost 1:				
riease note of		Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/30/2006
_	Type of treatment:	Conductive		Steam	ERH	<u>x</u>	Other:	RFH	
	Type of Contaminant:	 X Chlorinated Solve 	ents		Petroleum Hyd	lrocarbo	ns	Pesticides	
		Wood Treating			Other:				
	Treatment Status:	Active	<u>x</u>	Post	_				
	Type of Test:	<u>x</u> Pilot Test		Full Scale	e System				
	Start of Test:	<u>Jan-95</u>		End	of Test: Apr-95			Duration: 90 d	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: Kirkland A	AFB							_
	City, State, Zip Code:	· ·							
	OU# or Site #:								_
<u>x</u>	Primary point of contact:	Guggilam Sresty							
	Organization: <u>IIT Resear</u>	ch Institute							
	Address: 10 W. 35th St								
	City, State, Zip Code:	Chicago, IL 60616							
	Phone #: <u>312-567-4237</u>		(email:					_
<u>x</u>	Other contacts or vendors wh	ho worked on site			None				
	Point of contact: Jame	es Phelan							
	Type:Vendor, C	onsultant	_Vend	or, Techni	ical Applications		Ot	her	
	Organization: Sandia Na	tional Laboratories							
	Address: PO Box 5800								
	City, State, Zip Code:	Albuquerque, NM 871	85-580	00					
	Phone #: <u>505-845-9892</u>		•	email:					
Q,	A/QC								
	_ Characteristics of Interest								
		eatment groundwater data	l.		Good pre	e- and po	ost-treatme	ent soil data	
		file vs. time information			Flux asse	-			
	Groundwater elevation				Geologic		ection		
	Hydraulic Conductivit	y information							

0595

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0595</u>
Impacted	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
		=	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor V	Vells: Number of relevant m	nonitoring wells with ground					None
			Pre-treatment:		Post-treatment:		
	Number of wells relat	ive to treatment zone:	He are disease	D #1	0		
	Post-treatment	In: In:	Upgradient: Upgradient:	Downgradient: Downgradient:		ssgradient:ssgradient:	
	Post-treatment	III	opgradient:	Downgradient.		ssgradient	
Soil Boring	ns: Number of relevant so	il borings with pre-treatment	data:				
		il borings with post-treatmer					
	Number inside treatme			treatment zone:			
	rumber moide treatme	Ent Zono.	_ rumber outside				
Types of C	Contaminants						
/							
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
0							
Comme	nts:						
			-				
Attachmer	nts:						

Hydrogeologic Conceptua	al Model		Facility ID#: 0595
Geology:	al Model Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated so Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated so Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock)	sediments d sediments lower permeability material of higher permeability material sediments d sediments lower permeability material
Ground surface ele		Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl	Unknown
Is more than 1 aqui	fer present?	_	Unknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3	_ _ _
Flow direction			_
Horizontal hydraulic g	c gradient (feet/foot): radient (feet/foot):		Unknown
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
Transmissivity (ft2/d	low high day): Measured low high	using: Slug Test Laboratory	Unknown Field data Unknown
Comments:			
=			
Attachments:			

The	rmal Treatment - Design					Facility ID#:	<u>0595</u>
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Re	sistance				
		Steam	3 phase	6 phase	AC powe	rDC	power
			Steam	Steam + air	Steam + 0	D2	
.,	Type of Teet:	X Other (descri		 '			
<u>x</u>	Type of Test: <u>x</u>	•	Full-scal	•			
	_ Geology of Treatment Zone			mogeneous and perm			
			•	mogeneous and impe			ah ilitu maata sial
				eable sediments with		-	-
				meable sediments wi			neability material
			•	ut fractured bedrock ()	
	.			edrock, limestone, sar			
_	_ Treatment Targe Zone:	Saturated o	niy <u> </u>	Vadose only		urated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	<u>Jan-95</u>		Duratio	on: <u>90 d</u>		
	_ Hydraulic Control	Yes	No				
	To a transact Oall Danier						
	_ Treatment Cell Design:				**		6)
	Size of target zone (ft2):	Λ.	_			known (_ x ft)
	Thickness of target zone (f	,	_			known	
	Depth to top of target zone					known	
	Thickness of target zone b):			known	
	Number of energy delivery		_			known	
	Number of extraction point	S:	_		Un	known	
	Tomporatura Profiles						
	_ Temperature Profile:	o (dog C):				I Indonesia	
	Initial formation temperatur		ro (dog C):			Unknown	
	Maximum representative for	•				Unknown	
	Time to reach maximum re					Unknown	
	Duration of treatment at re	presentative tempe	rature (days):			Unknown	
				-	N-4-	T	(d O)
	Formation temperature imp	madiataly past trac	mont	<u> </u>	<u>Date</u>	Temperatu	ie (deg C)
	Formation temperature imm						
	Formation temperature pos Duration of post-treatment		ning event 1.	-			
	Duration of post-treatment	monitoring (days).					
	_ Mass of contaminant remo	ved:					
	_	liquid pumping:			lh.	lea	Unknow
					lb	kg	<u> </u>
		apor stream:			lb	kg	Unknow
	Tota	II:			lb	kg	Unknow
	Comments						
	Comments:						
	A44						
	Attachments:						

t and Performance					Facility ID#:	<u>0595</u>
_ Performance						
Remediation Goal:	_					
	_ In Groundwater: -					
	_ In Soil:					
Was the Remediation						
	_ In Groundwater _					
	Comment: -					
	-					
	_ In Soil _					
	Comment: -					
	_					
General comments of	on the thermal applica	ation:				
-						
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	kV	Vhr/yd ³
	al energy applied to t	reatment zone:			kWhr/m ³	kWhr/y
	er energy:				_ kWhr/m³	kWhr/y
		note other energy:		_	KVVIII/III	KVVIII/y
	Flease	note other energy.				
Cost						
Total Project Cost:						
Cor	nsultant Cost:					
·	rmal Vendor Cost:		<u></u>			
	ergy Cost:			_ m ³	_ yd ³	
	er Cost 1:				_ ,~	
	er Cost 1:					
·		-				
· 	er Cost 3:	Other Coot 4:				
Please note oth	iei cost:	Other Cost 1:				
		Other Cost 2:				

_ Other Cost 3:

<u>x</u> PD ____ File Analyzed By: Date: 10/19/2006 ____Steam Type of treatment: ___ Conductive ___ Pesticides Type of Contaminant: _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: **SVOCs** <u>X</u> Treatment Status: ___ Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: Nov-94 End of Test: Jun-95 Duration: varied Type of Site: ____Non-DOD __ DoD Facility Name: Sandia National Lab Address: City, State, Zip Code: Albuquerque, NM 87185 OU# or Site #: CLW Primary point of contact: Sandia Report: SAND97-1251 UC-2010 Organization: Address: City, State, Zip Code: Phone #: email: ____ Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0600

General Site Information

___ Hydraulic Conductivity information

General Site As	sessment Data					Facility II	D#: <u>0600</u>
Impacted	Impacted zone a	s defined by documentation			ness (ft):		Unknown
	Alternative metho	od for determining size of im	npacted zone (See source zo	ne definition attachmer	its)		
Monitor V	Vells: Number of relevant m	nonitoring wells with ground			Deet to store to		None
	Number of wells relati	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
x Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data: <u>4</u>				
	Number of relevant so	il borings with post-treatmer	nt data: 4				
	Number inside treatme	ent zone: 4	Number outside	treatment zone:	<u>0</u>		
x Types of 0	Contaminants						
,,				Average Pre-treatme	ent Concentration per		ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene						None
	Tetrachloroethene	Hexane	Creosote	None	None	None	
		Jet Fuel	x Total SVOCs	None	5 mg/kg	None	0.5 mg/kg
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
			-				
Attachmer	nts:						
							_
	-						

Hyd	rogeologic Conceptual	Model		Facility ID#: 0600
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ed sediments of lower permeability material s of higher permeability material sediments ed sediments of lower permeability material
<u>x</u>	Ground surface eleva	ation based on wells in o	adjacent to treatment zone: ft amsl	<u>x</u> Unknown
<u>x</u>	Aquifer Characteristic	cs:		
	Is more than 1 aquife	er present?	No Yes (number): <u>x</u>	Unknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3 185	
	_ Flow direction			_
<u>x</u>	Horizontal hydraulic g Vertical hydraulic gra	,		<u>X</u> Unknown <u>X</u> Unknown
<u>x</u>	K range (ft/day)	Measured low high	sing: Slug Test Laboratory	Field data X Unknown
	Transmissivity (ft2/da	_		
	Comments:			

The	rmal Treatment - Design						Fac	ility ID#:	<u>0600</u>	
<u>x</u>	Thermal treatment:	Conductive								
	_	Electrical R	esistance							
			3 phase		6 phase	AC	power	DO	power	
	_	Steam	·							
			Steam		Steam + air	Ste	am + O2			
	<u>x</u>	Other (desc		Power						
<u>X</u>	,, <u> </u>	lot test	Full-s							
<u>X</u>	Geology of Treatment Zone:				geneous and perme					
			•	•	geneous and imper					
		<u>X</u>			le sediments with i					
					able sediments wit		-	nigher peri	meability	materiai
					ractured bedrock (i	-	е госк)			
	Total and Tours 7 and a	0-11			ock, limestone, san		1.6 1	137.1		
<u>X</u>	_	Saturated	only	<u>X</u>	Vadose only		th (Saturated	and Vadose	zones)	
<u>X</u>	·	ov-94	NI.		Duratio	n: <u>33 d</u>				
	_ Hydraulic Control	Yes	No							
v	Treatment Cell Design:									
<u>x</u>	Size of target zone (ft2):			720			Unknown	(16 x	45 ft)
	Thickness of target zone (ft):			23			Unknown	`	<u>10</u> x	<u>45</u> II)
	Depth to top of target zone (ft	hae).		0			Unknown			
	Thickness of target zone below			0		_	Unknown			
	Number of energy delivery poi			<u>0</u> 29			Unknown			
	Number of extraction points:	1113.		<u>22</u> 6			Unknown			
	realiser of extraotion points.			<u>u</u>			Chichown			
<u>x</u>	Temperature Profile:									
_	Initial formation temperature (deg C):			<u>18</u>			_ Unknowi	n	
	Maximum representative form	ation temperat	ure (deg C):	:	<u>90</u>			Unknowi	1	
	Time to reach maximum repre	sentative temp	erature (da	ys):	<u>24</u>			Unknow	1	
	Duration of treatment at repres	sentative temp	erature (day	/s):	<u>9</u>			Unknowi	1	
					<u>D</u>	ate	-	Temperatu	re (deg (<u>C)</u>
	Formation temperature immed	liately post-trea	atment:				<u>85</u>			
	Formation temperature post-tr	eatment monit	oring event	1:	<u>55 days</u>		<u>25</u>			
	Duration of post-treatment mo	nitoring (days)	:		55 days					
<u>x</u>	Mass of contaminant removed	:								
	Via liqu	id pumping:				lb		_ kg		Unknow
	In vapo	r stream:				lb		_ kg		Unknow
	Total:					lb		_ kg	<u>x</u>	Unknow
	Comments:									
							=			
	Attachments:									

The	rmal Treatment - Design					Facility ID#:	0600
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Resis	stance				
		3 p	ohase	6 phase	AC po	wer I	OC power
	_	Steam					
		Ste	eam	Steam + air	Steam	+ O2	
	<u>X</u>	Other (describe	e) <u>RFH</u>				
<u>x</u>	Type of Test: <u>x</u> Pil	·	Full-scale S	-			
<u>x</u>	Geology of Treatment Zone:	Re	elatively homo	geneous and pern	neable unconsolid	dated sediments	
		· · · · · · · · · · · · · · · · · · ·	•	geneous and impe			
				ble sediments with			
							ermeability material
		· <u></u>	•	fractured bedrock	•	ck)	
				rock, limestone, sa			
<u>X</u>		Saturated only	y <u>x</u>	Vadose only		Saturated and Vado	se zones)
<u>X</u>		<u>ay-95</u>		Durat	ion: <u>29 d</u>		
	Hydraulic Control	Yes	No				
<u>x</u>	Treatment Cell Design:						
Δ	Size of target zone (ft2):		720		ī	Unknown (16 x 45 ft)
	Thickness of target zone (ft):		23			Unknown	<u>10 x 10 1t)</u>
	Depth to top of target zone (ft l	pae).	0			Unknown	
	Thickness of target zone below	= :	0			Unknown	
	Number of energy delivery point		<u>o</u> 29			Unknown	
	Number of extraction points:	110.	<u>25</u> 6			Unknown	
	rumber or extraorier pointer		<u>~</u>				
<u>x</u>	Temperature Profile:						
	Initial formation temperature (d	leg C):		<u>22</u>		Unknow	wn
	Maximum representative forma	ation temperature	(deg C):	100		Unknow	wn
	Time to reach maximum repres	sentative tempera	ature (days):	<u>22</u>		Unknow	wn
	Duration of treatment at repres	sentative tempera	ture (days):	9		Unknow	wn
					<u>Date</u>	<u>Tempera</u>	ture (deg C)
	Formation temperature immed	iately post-treatm	ent:			<u>150</u>	
	Formation temperature post-tre		ng event 1:	<u>55 days</u>		<u>80</u>	
	Duration of post-treatment mor	nitoring (days):		<u>55 days</u>			
~	Mass of contaminant removed						
<u>x</u>		d pumping:			lb	ka	Unknow
	·	r stream:			lb	kg kg	Unknow
	Total:	Sileani.	-		lb		
	i otai.				10	kg	<u>X</u> Unknow
	Comments:						
	Attachments:						

Cost and Perfor	rmance				Facility ID#:	<u>0600</u>
Performar	nce					
Remediati	ion Goal:					
	In Groundwater: —					
	In Soil:					
Was the F	Remediation Goal Achieved:					
	In Groundwater					
	Comment: —					
	la Cail					
	In Soil					
	Comment: —					
	_					
General c	omments on the thermal applicat	ion:				
						
						_
Lessons L	Learned					
Pow	ver Line - 45,000 kWhr				D-45- E	00 000 IAM/Is
					Radio Freque	ency - 30,000 kWhi s based on the tota
treat	ted area over the course of the he	eatings so 6000 yd3				
<u>x</u> Energy						
	rgy Used: <u>75000</u>		<u>x</u> kWhr	kWhr/m ³	kW	/hr/vd ³
Total Ello	Total energy applied to tre	eatment zone:	<u> </u>		kWhr/m ³	kWhr/yd ³
	Other energy:				_ kWhr/m³	kWhr/yd ³
		ote other energy:			KVVIII/III	KWIII/yd
	Flease II	ote other energy.				
x Cost						
Total Proje	ect Cost: 15	1 /cubic yard				
	Consultant Cost:					
	Thermal Vendor Cost:					
	x Energy Cost:	14.87	_	m³ <u>x</u>	yd ³	
	Other Cost 1:	<u> </u>	_		·	
	Other Cost 2:					
	Other Cost 3:					
Plea	ase note other cost:	Other Cost 1:				
Flea						
		Other Cost 2:				
		Other Cost 3:				

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	7/12/2007
	Type of treatment:	Conductive	<u>x</u> . S	Steam	ERH	Other:		
	Type of Contaminant:	x Chlorinated Solv	ents/		Petroleum Hydroca	rbons	Pesticides	
		Wood Treating			Other:			
	Treatment Status:	Active	<u>x</u> I	Post				
	Type of Test:	Pilot Test	<u>x</u> I	Full Scale	System			
	Start of Test:	<u>Jan-91</u>		End o	f Test:		Duration:	
	Type of Site:	<u>x</u> Non-DOD	I	DoD				
<u>x</u>	Facility Name: Former A	T&T Skokie Works						
	Address:							_
	City, State, Zip Code:	Skokie, IL						
	OU# or Site #:							_
<u>x</u>	Primary point of contact:	Dennis Sopcich						
	Organization: <u>ENSR Co</u>	rporation						
	Address:							
	City, State, Zip Code:							
	Phone #: <u>630-836-1700</u>		eı	mail:				
<u>x</u>	Other contacts or vendors w	ho worked on site			None			
	Point of contact: <u>Star</u>	n Komperda						
	Type:Vendor, C	Consultant	_ Vendo	r, Technic	al Applications	Oth	ner	
	Organization: <u>IL EPA</u>							
	Address: 1201 N. Grand	Ave. E.						
	City, State, Zip Code:	Springfield, IL 62794-	<u>-9276</u>					
	Phone #:		_ ei	mail:				
Q	A/QC							
	0							
	_ Characteristics of Interest				<i>a</i> .			
	Good pre- and post-tre				Good pre- an	_	nt soil data	
	Good temperature pro				Flux assessm			
	Groundwater elevation				Geologic cro	ss-section		
	Hydraulic Conductivit	ty information						

0610

General Site Information

G	eneral Site Ass	sessment Data				Facility II	D#: <u>0610</u>		
	Impacted 2	Impacted zone a	ength (parallel to flow direction)(ft.): Width (ft): Thickness (ft): Impacted zone as defined by documentation Alternative method for determining size of impacted zone (See source zone definition attachments) Map attachment						
_	Monitor W	/ells: Number of relevant m	nonitoring wells with grounds	vater data: Pre-treatment:		Post-treatment:		None	
		Number of wells relat Pre-treatment Post-treatment	Number of wells relative to treatment zone: Pre-treatment In: Upgradient: Downgradient: Crossgradient:						
Soil Borings: Number of relevant soil borings with pre-treatment data: Number of relevant soil borings with post-treatment data: Number inside treatment zone: Number outside treatment zone: Types of Contaminants									
					Average Pre-treatme Chen		Average Post-treatme	ent Concentration per nical:	
_		Chlorinated Solvents:	Petroleum Hydrocarbons:	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
		Trichloroethene	Hexane	Creosote	None	None	None	None	
		Tetrachloroethene	Jet Fuel		None	None	None	None	
		1,1-dichloroethene	Napthalene		None	None	None	None	
		cis-1,2-dichloroethene	Benzene		None	None	None	None	
		trans-1,2-dichloroethene	Tolune		None	None	None	None	
		1,1-dichloroethane	Ethylbenzene		None	None	None	None	
		1,2-dichloroethane	m/p-xylene		None	None	None	None	
		1,1,1-trichloroethane	o-xylene		None	None	None	None	
١ (Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None	
		1,1,2,2-tetrachloroethane			None	None	None	None	
		Vinyl Chloride			None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
					None	None	None	None	
	Commer	nts:							
	Attachmen	ts:					·		
		·		·					

Hydrogeologic Conceptu	al Model		Facility ID#: 0610
Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers. Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments with inter-bedded layers. Largely permeable sediments with inter-bedded layers. Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers. Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	d sediments lower permeability material of higher permeability material sediments d sediments lower permeability material
Ground surface ele	vation based on wells in o	or adjacent to treatment zone: ft amsl	Unknown
Aquifer Characteris	etics:		
Is more than 1 aqui	ifer present?	No Yes (number): U	Jnknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3	- - -
Flow direction			_
Horizontal hydraulic g	c gradient (feet/foot): radient (feet/foot):		Unknown
K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data
Transmissivity (ft2/	high day): Measured low high	using:Slug TestLaboratory	Field dataUnknown
Comments:			
Attachments:			

The	rmal Treatment - Design								Facility ID#:	<u>0610</u>
<u>x</u>	Thermal treatment:		_ Cond	uctive						
			_ Electr	rical Resistance						
		<u>x</u>	Steam	3 phase	_	6 phase		_AC power	DO	C power
		-		Steam	_	Steam + air		_Steam + O2		
V	Torre of Torty	D.1		(describe)	1.6					
<u>X</u>	Type of Test: X		t test	<u></u>	-scale Syst	em neous and perme	abla un	oonoolidatad	andimenta	
<u>X</u>	Geology of Treatment Zone	ð.				neous and perme				
						sediments with in				ability material
				_					· ·	meability material
					•	ctured bedrock (i.		•	or migner per	meability material
						k, limestone, sand	-	a		
	_ Treatment Targe Zone:		Satur	·		dose only		Both (Satura	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	Jan-		,		Duration		_ (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
_	Hydraulic Control		Yes	No						
	_ Treatment Cell Design:									
	Size of target zone (ft2):						_	Unkno	own (_ x ft)
	Thickness of target zone (ft): Depth to top of target zone (ft bgs): Thickness of target zone below water table (ft):						_	Unkno	own	
							_	Unkno	own	
							_	Unkno	own	
	Number of energy delivery points:						_	Unkno	own	
	Number of extraction points	S:					_	Unkn	own	
	_ Temperature Profile:									
	Initial formation temperature	e (de	g C):						Unknow	n
	Maximum representative for	rmat	ion tem	perature (deg 0	C):				Unknow	n
	Time to reach maximum re	prese	entative	temperature (c	lays):				Unknow	n
	Duration of treatment at rep	rese	ntative	temperature (d	ays):	-			Unknow	n
						<u>Da</u>	<u>ate</u>		<u>l emperati</u>	ire (deg C)
	Formation temperature imn					-				
	Formation temperature pos Duration of post-treatment			-	и т.					
	Duration of post-treatment	HIOH	toring (uays).						
	_ Mass of contaminant remov	ved:								
	_		pumpir	ua.				_ lb	kg	Unknown
			stream:	-				_ lb	kg	Unknown
	Tota		otrouri.	_				_ lb	kg	Unknown
	7000	•							<u>~</u> 5	Chanowii
	Comments:									
	1st Phase	e - in	itiated	1991 and expa	anded in	1993. The syste	em was	closed via	EPA-approva	ıl
	Attachments:									

Note: When applicable, mass flux measurements from Groundwater Services, Inc. freeware is attached.

Performance Remediation Goal: In Groundwater:					
In Groundwater:					
In Soil:					
Was the Remediation Goal Achieved:					
In Groundwater					
Comment:					
Comment.					
In Soil					
Comment:					
Comment					
•					
General comments on the thermal appli	cation:				
Lessons Learned					
		_			
_					
Energy			2		
Total Energy Used:		kWhr	kWhr/m ³		
Total energy applied to	treatment zone:			_ kWhr/m³	kWhr/y
Other energy:				_ kWhr/m ³	kWhr/y
Pleas	e note other energy:				
Cost					
Total Project Cost:					
Consultant Cost:					
Thermal Vendor Cost:			3	.3	
	_		_ m³	_ yd³	
Energy Cost:					
Other Cost 1:					
Other Cost 1: Other Cost 2:					
Other Cost 1:	<u> </u>				

__ Other Cost 3:

General Site Information Facility ID#: 0611 JT <u>x</u> PD ____ File Analyzed By: Date: 7/12/2007 Type of treatment: ___ Conductive ____ Steam x ERH ____Other: Type of Contaminant: Chlorinated Solvents _ Petroleum Hydrocarbons _____Pesticides _Wood Treating ____Other: Treatment Status: ___ Active Post X Type of Test: Pilot Test x Full Scale System Start of Test: 6/4/1998 End of Test: <u>4/30/1999</u> Duration: 8 months Type of Site: x Non-DOD __ DoD Facility Name: Former AT&T Skokie Works Address: City, State, Zip Code: Skokie, IL OU# or Site #: ____ Primary point of contact: Dennis Sopcich Organization: **ENSR Corporation** Address: __ City, State, Zip Code: Phone #: 630-836-1700 email: Other contacts or vendors who worked on site __ None Stan Komperda Vendor, Consultant _____ Vendor, Technical Applications ____Other Type: Organization: IL EPA Address: 1201 N. Grand Ave. E. City, State, Zip Code: Springfield, IL 62794-9276 Phone #: _____ email: _____ QA/QC _ Characteristics of Interest ____ Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ___ Good temperature profile vs. time information _ Flux assessment

____ Geologic cross-section

____ Groundwater elevations

_____ Hydraulic Conductivity information

General Site As	sessment Data					Facility ID	D#: <u>0611</u>				
Impacted	Zone: Length (parallel to flow	w direction)(ft.):	Width (ft):	Thickn	ess (ft):		Unknown				
	Impacted zone a	as defined by documentation									
	Alternative meth	nod for determining size of im	pacted zone (See source :	zone definition attachment	s)						
	Map attachment	Map attachment									
Monitor V	Wells: Number of relevant n	Number of relevant monitoring wells with groundwater data:									
			Pre-treatmen	t: I	Post-treatment:						
	Number of wells relat	tive to treatment zone:									
	Pre-treatment	In:	Upgradient:	Downgradient: _	Cro	ssgradient:					
	Post-treatment	In:	Upgradient:	Downgradient: _	Cro	ssgradient:					
Soil Borin	gs: Number of relevant so	oil borings with pre-treatment	data:								
	Number of relevant so	oil borings with post-treatmen	t data:								
	Number inside treatme	ent zone:	Number outsi	de treatment zone:							
			_								
Types of 0	Contaminants										
				Average Pre-treatmen Chemi		Average Post-treatme Chen					
	Chlorinated Solvents:	Petroleum Hydrocarbons:	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	x Trichloroethene	Hexane	Creosote	None	None	1 mg/L	None				
	Tetrachloroethene	Jet Fuel		None	None	None	None				
	x 1,1-dichloroethene	Napthalene		None	None	0.01 mg/L	None				
	x cis-1,2-dichloroethene	Benzene		None	None	1 mg/L	None				
	x trans-1,2-dichloroethene	Tolune		None	None	0.1 mg/L	None				
	x 1,1-dichloroethane	Ethylbenzene		None	None	0.1 mg/L	None				
	1,2-dichloroethane	m/p-xylene		None	None	None	None				
	x 1,1,1-trichloroethane	o-xylene		None	None	None	None				
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None				
Concom	1,1,2,2-tetrachloroethane			None	None	None	None				
	X Vinyl Chloride			None	None	1 mg/L	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
Comments:											
	Data from the 1st ERH	expand the system	m. The whole system	was also down the							
	Data i Sili tilo Tot EltiT	2,5.co system was		nole month of October.		The inicia system	also down ale				
Attachmer	nts:										

Hyd	rogeologic Conceptua	al Model				Facility ID#:	<u>0611</u>				
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated	<u>Sediments</u>							
		Vadose Zone:	Relatively	nomogeneous and permeab	le unconsolidated se	ediments					
			Relatively	nomogeneous and imperme	able unconsolidated	sediments					
			x Largely pe	rmeable sediments with inte	r-bedded lenses of I	ower permeability ma	aterial				
			Largely im	permeable sediments with in	nter-bedded layers o	f higher permeability	material				
			Competen	t, but fractured bedrock (i.e.	crystalline rock)						
			Weathered	l bedrock, limestone, sandst	one						
		Saturated Zone:	Relatively	nomogeneous and permeab	le unconsolidated se	ediments					
			Relatively	nomogeneous and imperme	able unconsolidated	sediments					
			Largely pe	rmeable sediments with inte	r-bedded lenses of I	ower permeability ma	aterial				
			 Largely impermeable sediments with inter-bedded layers of higher permeability material 								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
<u>x</u>	Ground surface elev	vation based on wells in	or adjacent to trea	atment zone: 9	ft amsl	Unkno	own				
<u>x</u>	Aquifer Characterist	tics:									
	Is more than 1 aquit	fer present?	No	Yes (number):	U	nknown (assume single	aquifer)				
			Aquifer 1	Aquifer 2	Aquifer 3						
	Depth to water:	low value (ft bgs):				-					
		high value (ft bgs):				-					
		Unknown:				-					
	_ Flow direction					_					
	_ Horizontal hydraulic	gradient (feet/foot):				Unkno	own				
	Vertical hydraulic gr	radient (feet/foot):				Unkno	own				
	_ K range (ft/day)	Measure	d using:	Slug Test Labo	ratory	Field data					
		low				Unkno	own				
		high				_					
	Transmissivity (ft2/c	_	d using:	Slug Test Labo	ratory	Field data					
	·	low				Unkno	own				

low high

Comments:

The	rmal Treatment - Design								Facility ID#:	<u>0611</u>	
<u>x</u>	Thermal treatment:		_ Conductiv	e							
		<u>x</u>	Electrical	Resistance							
			Steam	_ 3 phase	<u>x</u>	6 phase		_AC powe	er D	C power	
		-		Steam		_ Steam + air	_	_Steam + 0	02		
			Other (des								
<u>X</u>	Type of Test:	_ Pilot		_	cale System						
<u>X</u>	Geology of Treatment Zone	9:		-	-	ous and perme					
					ū	·			dated sediments		
			<u>X</u>						•	eability material rmeability materia	al
				_		ured bedrock (i.		•		meability materia	וג
			· · · · · · · · · · · · · · · · · · ·	_		limestone, sand	-		,		
<u>x</u>	Treatment Targe Zone:		Saturated	_ '	Vad		<u>x</u>	Both (Sat	urated and Vados	se zones)	
<u>x</u>	Start of Thermal Test:	6/4/	1998	•		Duration		onths			
	_ Hydraulic Control		_Yes	No							
	Treatment Cell Design:										
	Size of target zone (ft2):						_	Un	known (_	x ft))
	Thickness of target zone (f	t):					_	Un	known		
	Depth to top of target zone			_	Un	known					
	Thickness of target zone be	elow v	water table	(ft):			_	Un	known		
	Number of energy delivery			_	Un	known					
	Number of extraction points	s:					_	Un	known		
	_ Temperature Profile:	,.	5)								
	Initial formation temperatur		-						Unknov		
	Maximum representative fo		•						Unknow		
	Time to reach maximum re			. `	• /				Unknov		
	Duration of treatment at rep	orese	ntative tem	perature (day	/S):				Unknov	/n	
						Da	ate		Temperat	ture (deg C)	
	Formation temperature imr	nedia	tely post-tre	eatment.		<u> </u>	<u> </u>		romporat	are tack of	
	Formation temperature pos				1:				-		
	Duration of post-treatment			-							
	·										
<u>x</u>	Mass of contaminant remove	ved:									
	Via	iquid	pumping:					_ lb	kg	Unknow	wn
	In va	apor s	stream:		2720	<u>12</u>	<u>x</u>	lb	kg	Unknow	wn
	Tota	ıl:			6685	<u>50</u>	<u>x</u>	lb	kg	Unknow	wn
	Comments:										
	ERH by	batte	lle begain	in June of 1	998 and 6	expanded in 12	2/98 &	1/99 and o	perated until A	<u>spril 1999</u>	
	Attachments:										
											_

Note: When applicable, mass flux measurements from Groundwater Services, Inc. freeware is attached.

Cost and Performance Facility ID#: 0611

<u>(</u>	Performance					
	Remediation Goal:					
	<u>x</u> In Groundwater:	<u>Re</u>	each risk-based targe	t cleanup level	s (RBTCLs)	
		<u>trans-1,2-DCE- 70,900 ι</u>			1,1,1-TCA - 9,650 ug/ nyl Chloride - 945 ug/L	
	In Soil:	<u>,ooo ag/2,</u>	1,1 2011 110,000	ug/E) and vii	191 O 110 1197 E	
	11 3011.					
	Was the Remediation Goal Achieved:					
	In Groundwater					
	Comment:					
	In Soil					
	Comment:					
	General comments on the thermal appli	ication:				
	Site was closed after reaching the	RBTCLs via IL EPA appr	<u>roval.</u>			
	Lessons Learned					
	Lessons Learned					
	-					
						
	_ Energy					
	Total Energy Used:		kWhr	kWhr/m ³	kWhr/yd ³	
	Total energy applied to	o treatment zone:			kWhr/m ³	_ kWhr/yd ³
	Other energy:				kWhr/m ³	_ kWhr/yd ³
						_ KVVIII/ya
	Pleas	se note other energy:	_			
	Cost					
	Total Project Cost:					
	Consultant Cost:					
						
	Thermal Vendor Cost:					
	Energy Cost:		n	n ³	_yd³	
	Other Cost 1:					
	Other Cost 2:					
	Other Cost 3:					
	Please note other cost:	Other Cost 1:				
		Other Cost 2:		_		
		Other Cost 3:		_		
		Other Cost 3:				

4/5/2005 File Analyzed By: Date: PD ____ ERH Type of treatment: Conductive Steam ____Other: Type of Contaminant: _Chlorinated Solvents Petroleum Hydrocarbons Pesticides _ Wood Treating Other: **PCBs** <u>X</u> Treatment Status: _Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: Jan-96 End of Test: Mar-96 Duration: ~36 hours Type of Site: ___Non-DOD __ DoD Facility Name: South Glens Falls Dragstrip Address: Route 9 City, State, Zip Code: Moreau, Saratoga County, New York OU# or Site #: Primary point of contact: RT Environmental Engineering Organization: Address: 215 W. Church Rd City, State, Zip Code: King of Prussia, PA 19406 Phone #: email: _ Other contacts or vendors who worked on site _None Point of contact: Ralph Baker Type: Vendor, Consultant ____ Vendor, Technical Applications __Other Organization: **TerraTherm** Address: 10 Stevens Road City, State, Zip Code: Fitchburg, MA 01420 Phone #: <u>978-343-0300</u> email: rbaker@terratherm.com QA/QC __ Characteristics of Interest __Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data Good temperature profile vs. time information Flux assessment _ Groundwater elevations Geologic cross-section

Facility ID#:

0620

General Site Information

<u>x</u> Impact	ed Zone:	Length (parallel to flow		_	Width (ft):	Thick	xness (ft):		<u>x</u>	Unknown	
			is defined by documentation								
			od for determining size of in	pact	ed zone (See source zo	one definition attachmer	nts)				
		Map attachment									
<u>x</u> Monito	or Wells:	Number of relevant m	nonitoring wells with ground	water					<u>x</u>	None	
					Pre-treatment:		Post-treatment:				
		Number of wells relat					_				
		Pre-treatment	In:		pgradient:	Downgradient:		rossgradient:			
		Post-treatment	In:	U	pgradient:	Downgradient:		rossgradient:			
x Soil Bo	rings:	Number of relevant soil borings with pre-treatment data: 35									
	-	Number of relevant so	of relevant soil borings with post-treatment data: 58								
		Number inside treatme				e treatment zone:	8				
			<u> </u>				_				
x Types	of Contamina	nts									
							ent Concentration per nical:	Average Post-treatn Che	mical:		
	Cł	lorinated Solvents	Petroleum Hydrocarbons		Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)	
	Tric	hloroethene	Hexane		Creosote	None	None	None		None	
	Tetr	achloroethene	Jet Fuel	<u>x</u>	Arclor 1254	None	None	None		None	
	1,1-	dichloroethene	Napthalene	<u>x</u>	Arclor 1260	None	500 mg/kg	None	(0.1 mg/kg	
	cis-	1,2-dichloroethene	Benzene	<u>x</u>	<u>PCBs</u>	None	None	None		None	
	tran	s-1,2-dichloroethene	Tolune			None	None	None		None	
	1,1-	dichloroethane	Ethylbenzene			None	None	None	<u> </u>	None	
	1,2-	dichloroethane	m/p-xylene			None	None	None	<u> </u>	None	
Chemicals	1,1,	1-trichloroethane	o-xylene			None	None	None		None	
Concern		2-trichloroethane				None	None	None		None	
	1,1,	2,2-tetrachloroethane				None	None	None	<u> </u>	None	
	Vin	yl Chloride				None	None	None	<u> </u>	None	
						None	None	None	<u> </u>	None	
						None	None	None	<u> </u>	None	
						None	None	None	<u> </u>	None	
						None	None	None		None	
						None	None	None	<u> </u>	None	
						None	None	None		None	
Com	ments:										
	_										
Attachr	nonto:										
Allachr	nents								_		
									—		

Facility ID#:

0620

General Site Assessment Data

Hydrogeologic Conceptual Model Facility ID#: 0620

<u>x</u> Geology: Zone Unconsolidated Sediments

<u>×</u>	Geology.	<u> </u>	one	Uncons	olidated Sec	annenis				
		Vadose	Zone:	<u>x</u> Re	latively hom	ogeneous	and permeabl	e unconsolidated s	ediments	
				Re	latively hom	ogeneous	and impermea	able unconsolidated	d sediments	
				La	rgely perme	able sedim	ents with inter	-bedded lenses of	lower permeabi	lity material
				La	rgely imperr	neable sedi	iments with in	ter-bedded layers o	of higher permea	ability material
								crystalline rock)		
							stone, sandsto			
		Saturat	ed Zone:						ediments	
		Gatara	ou 20110.	Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments						
				Largely permeable sediments with inter-bedded lenses of lower permeability materialLargely impermeable sediments with inter-bedded layers of higher permeability material						
								crystalline rock)	i nigher penner	ability material
					•		,	,		
				vve	athered bed	urock, iimes	stone, sandsto	one		
	Current accuracy	alavatian baas	م من مالمین می اس					61		TT.1
<u>x</u>	Ground surface	elevation base	ea on wells in a	r adjacen	to treatmer	nt zone:		ft amsl	<u>x</u>	Unknown
<u>X</u>	Aquifer Characte		_		_			_		
	Is more than 1 a	quifer present	?	_ No		es (number)			Jnknown (assum	e single aquifer)
				Aqui	ifer 1	A	quifer 2	Aquifer 3		
	Depth to water:	low val	ue (ft bgs):	<u>22</u>		-			_	
		high va	lue (ft bgs):	<u>28</u>					_	
		Unknov	vn:						_	
	Flow direction								_	
<u>x</u>	Horizontal hydra	ulic gradient (feet/foot):						<u>x</u>	Unknown
	Vertical hydrauli	c gradient (fee	t/foot):						<u>x</u>	Unknown
<u>x</u>	K range (ft/day)		Measured	using:	Slu	ıg Test	Labo	ratory _	Field data	
			low					·	<u>x</u>	Unknown
			high				_		<u> </u>	
	Transmissivity (f	t2/day):	Measured	using:	Slu	g Test	Labo	ratory	Field data	
			low						<u>x</u>	Unknown
			high							
			3			-			_	
	Comments:									
	Commonto.									
	Attachments:	The good to	mnerature nr	ofile data	are found	in the FS8	T article The	en et al. 1996, Vol	30 No. 11 no	n 3144-3154
	Audumiterus.	Fig. 3	mporature pr	omo uata	are round		a i ditiole, ibe	71 St al. 1990, VOI	. 50 140. 11, p	
		a,b								

The	rmal Treatment - De	sign							Facility ID#:	0620
<u>x</u>	Thermal treatment	: <u>x</u>	Conductiv	e <u>The</u>	rmal Bla	ankets_				
			_ Electrical	Resistance						
			Steam	_ 3 phase		6 phase		AC power	D	C power
				Steam		Steam + a	air	Steam + O	2	
			Other (des	cribe)						
<u>x</u>	Type of Test:	<u>x</u> Pilo	t test	Full	-scale S	ystem				
<u>x</u>	Geology of Treatm	ent Zone:	<u>x</u>	Relatively	/ homo	geneous and p	ermeable u	nconsolidate	d sediments	
			_	_ Relatively	/ homo	geneous and ir	npermeable	unconsolida	ated sediments	
				_ Largely p	ermeal	ole sediments v	vith inter-be	dded lenses	of lower perme	eability material
			_	_ Largely ir	nperme	able sediment	s with inter-	bedded laye	rs of higher pe	rmeability material
			_	_ Compete	nt, but	ractured bedro	ck (i.e. crys	stalline rock)		
			_	_ Weathere	ed bedr	ock, limestone,	sandstone			
<u>x</u>	Treatment Targe Z	lone:	_ Saturated	only	<u>x</u>	Vadose only		Both (Satu	rated and Vados	e zones)
<u>x</u>	Start of Thermal To	est: <u>Jan-</u>	96			Du	ration: 36	hours		
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No						
<u>x</u>	Treatment Cell De	sign:								
	Size of target zone	(ft2):			4800			Unk	nown (<u>20</u> x <u>40</u> ft)
	Thickness of targe	t zone (ft):			1			Unk	nown	
	Depth to top of targ	get zone (ft bo	gs):		<u>0</u>			Unk	nown	
	Thickness of target zone below water table (ft): $\underline{0}$						Unk	nown		
	Number of energy	delivery point	is:		<u>6</u>			Unk	nown	
	Number of extracti	on points:			N/A			Unk	nown	
<u>x</u>	Temperature Profil	e:								
_	Initial formation ter		g C):						<u>x</u> Unknow	'n
	Maximum represei			ature (deg C	C):	220			Unknow	'n
	Time to reach max		•			1			Unknow	
	Duration of treatme	-				<u>>1</u>			Unknow	'n
		·		,	• •	_				
	Formation tempera	aturo immodia	atoly post tr	oatmont:			<u>Date</u>		Temperat	ure (deg C)
	Formation tempera				·+ 1·					
	Duration of post-tre	•		-	и т.					
	Manager of another in									
<u>x</u>	Mass of contamina							11.	1	TI-1
		•	pumping:					lb	kg	Unknown
		In vapor s	stream:			60.2		lb	<u>x</u> kg	Unknown
		Total:					_	lb	kg	Unknown
	Comments:	trootmost =	alla · 4 A	25 hours	(1/20/0	6 to 1/21/00\-	1D 00	houre (4/04	/06 3/3/06\- 1	20 hours
	_	<u> treatment ce</u> 2/4/96 - 2/5/9								<u>2A - 29 hours</u> - 39 hours (2/8/96
	_	/10/96)				Estimated &				
	Attachments:									
	_									

Cost and Performance Facility ID#: 0620 Performance Remediation Goal: In Groundwater: -In Soil: Show effectiveness of ISTD in surface soils on PCBs and show no impact on human health Was the Remediation Goal Achieved: ____ In Groundwater Comment: In Soil X Comment: Yes, below 2ppm to 18 inches. No high emissions General comments on the thermal application: Lessons Learned Energy __ kWhr/yd³ ____ kWhr/m³ Total Energy Used: ____ kWhr 5.5 GJ* ___ kWhr/yd³ x Total energy applied to treatment zone: ____ Other energy: _ kWhr/m³ ___ kWhr/yd³ _ Please note other energy: * from Iben et al. 1996 ES&T paper, Table 5. Cost Total Project Cost: ____ Consultant Cost: ____ Thermal Vendor Cost: ____ Energy Cost:

Other Cost 1:
Other Cost 2:
Other Cost 3:

Other Cost 1:
Other Cost 2:
Other Cost 3:
Please note other cost:

File Analyzed By: Date: 11/4/2006 PD ____ ____Steam ____Other: Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents _ Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: _ Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: _____ Type of Site: ___DoD Non-DOD Facility Name: West Side Corporation Site Address: City, State, Zip Code: Jamaica, New York OU# or Site #: Primary point of contact: Jon Sundquist Organization: Address: City, State, Zip Code: Phone #: <u>716-856-5636</u> email: ____ Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: Vendor, Consultant __ Other New York Department of Environmental Conservation Address: Remedial Bureau E, 12th Floor, 625 Broadway City, State, Zip Code: Albany, NY 12233-7017 Phone #: <u>518-402-9814</u> email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0625

General Site Information

General Site Assessment Data								
	Impacted	= "	direction)(ft.):		Thick	ness (ft):	<u> </u>	Unknown
			s defined by documentation					
			od for determining size of im	pacted zone (See source zo	ne definition attachmer	its)		
		Map attachment						
	Manager 14	Malla. North and for larger	and the state of t					N.
•	Monitor V	veils: Number of relevant m	onitoring wells with grounds			Post-treatment:		None
		Number of wells relati	ive to treatment zone:	Pre-treatment:		Post-treatment:		
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
		rost-treatment		opgradient.	Downgradient.		ssgradient	
	Soil Boring	ns: Number of relevant so	il borings with pre-treatment	data:				
			il borings with post-treatmen					
		Number inside treatme			treatment zone:			
		rumbor morae troutine		_ Trainibor outoido				
	x Types of C	Contaminants						
					Average Pre-treatme Chen	ent Concentration per	Average Post-treatme	ent Concentration per
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
Ī		x Trichloroethene	Hexane	Creosote	None	None	None	None
		x Tetrachloroethene	Jet Fuel		None	None	None	None
l		1,1-dichloroethene	Napthalene		None	None	None	None
l		x cis-1,2-dichloroethene	Benzene		None	None	None	None
l		x trans-1,2-dichloroethene	Tolune		None	None	None	None
l		x 1,1-dichloroethane	Ethylbenzene		None	None	None	None
l		1,2-dichloroethane	m/p-xylene		None	None	None	None
l		x 1,1,1-trichloroethane	o-xylene		None	None	None	None
l	Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
l	001100111	1,1,2,2-tetrachloroethane			None	None	None	None
l		X Vinyl Chloride			None	None	None	None
l		-	x Ethylbenzene		None	None	None	None
l			x MTBE		None	None	None	None
l			x <u>Toluene</u>		None	None	None	None
l			x Trichlorofluoromethane		None	None	None	None
l					None	None	None	None
l					None	None	None	None
		<u>-</u>						
	Comme	nts:						-
								
	Attachmer	nts:						

Hyd	rogeologic Conceptual	Model				Facility ID#:	0625
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relatively Largely in Competer Weathere Relatively Relatively Largely in Competer	w homogeneous and per w homogeneous and impermeable sediments with intermeable sediments and, but fractured bedrock and bedrock, limestone, so w homogeneous and per w homogeneous and impermeable sediments with	rmeable unconsolidated so permeable unconsolidated th inter-bedded lenses of le with inter-bedded layers o k (i.e. crystalline rock)	sediments ower permeability materia f higher permeability materia ediments sediments ower permeability materia	ərial al
<u></u>	Ground surface eleval Aquifer Characteristic Is more than 1 aquife Depth to water:	low value (ft bgs):			ft amsl t	Unknown Inknown (assume single aqu 	
	_ Flow direction _ Horizontal hydraulic (Unknown: gradient (feet/foot):				Unknown	
	Vertical hydraulic gra _ K range (ft/day)	dient (feet/foot): Measured	using:	Slug Test	_ Laboratory	Unknown Field data	
	Transmissivity (ft2/da	low high				Unknown Field data Unknown	

Ther	mal Treatment - Design							Fac	cility ID#:	<u>0625</u>
<u>x</u>	Thermal treatment:		Conductive	·						
_		x	Electrical F							
				3 phase	_	6 phase		AC power	DC	power
			Steam	Steam	_	Steam + air		Steam + O2		
			Other (desc	cribe)						
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Full-	scale Syste	m				
<u>x</u>	Geology of Treatment Zone	: :		Relatively	homogen	eous and permea	able und	consolidated sec	diments	
				Relatively	homogen	eous and impern	neable u	inconsolidated s	sediments	
			<u>x</u>	Largely pe	ermeable	sediments with in	ter-bed	ded lenses of lo	wer perme	ability material
									higher perr	neability material
						tured bedrock (i.e		Illine rock)		
				-		, limestone, sand	Istone			
<u>X</u>	Treatment Targe Zone:		Saturated	only	Va	-	<u>x</u>	Both (Saturated	and Vadose	zones)
	_ Start of Thermal Test:					Duration	ı:			
-	_ Hydraulic Control		Yes	No						
~	Treatment Cell Design:									
<u>x</u>	Size of target zone (ft2):				1200			Unknown	((60 x 60 ft)
	Thickness of target zone (ft	١٠			45			Unknown	_	<u>50</u> x <u>50</u> h)
	Depth to top of target zone		3).		10			Unknown		
	Thickness of target zone be			(ft):	40			Unknown		
	Number of energy delivery			()-				Unknown		
	Number of extraction points	-					-	Unknown		
	·									
	Temperature Profile:									
	Initial formation temperature	e (deg	(C):						Unknown	ı
	Maximum representative fo	rmatio	on tempera	ture (deg C):				Unknown	ı
	Time to reach maximum re	prese	ntative tem	perature (da	ays):				Unknown	ı
	Duration of treatment at rep	reser	tative temp	erature (da	ıys):				Unknown	ı
						<u>Da</u>	<u>ite</u>		Temperatu	re (deg C)
	Formation temperature imm	nediat	ely post-tre	atment:						
	Formation temperature pos	t-trea	ment moni	toring event	t 1:					
	Duration of post-treatment	monite	oring (days)):						
	_Mass of contaminant remov	/ed:								
	Via I	iquid _l	oumping:					. lb	kg	Unknown
			ream:				_	. lb	kg	Unknown
	Tota	l:						. lb	kg	Unknown
	Comments:									
	Attachments:									

ost and Performance					Facility ID#:	<u>0625</u>
Performance						
Remediation Goal:						
	In Groundwater:					
	_					
	In Soil:					
W 4 5 F 6	0 141: 1					
Was the Remediation						
	In Groundwater					
	Comment:					
	In Soil					
	Comment:					
	Comment.					
General comments	on the thermal appli	ication:				
Objective - Re	educe the mass of co	ontaminants in source are contributing to the plume	eas as much as p	oracticable, so th	nat when off-site G	W extraction begin
111010 13 1033 3	ource contamination	contributing to the plante	<u> </u>			
Lessons Learned						
-						
Energy						
Total Energy Used:			kWhr	kWhr/i	m ³ k)	Whr/yd ³
		trootment zener	KWIII	KVVIII/I	kWhr/m ³	
	tal energy applied to	treatment zone:				kWhr/yd ³
Ot	her energy:	_			kWhr/m ³	kWhr/yd ³
	Pleas	se note other energy:	-			
Cost						
Total Project Cost:						
-	onsultant Cost:					
						
	ermal Vendor Cost					
	ermal Vendor Cost: ergy Cost:			m³	yd³	
	ergy Cost:			m³	yd³	
Ot	nergy Cost: her Cost 1:		<u> </u>	m³	yd³	
	nergy Cost: her Cost 1: her Cost 2:			m³	yd³	
Ot	her Cost 1: her Cost 2: her Cost 3:			m³	yd³	
	her Cost 1: her Cost 2: her Cost 3:	Other Cost 1:		m³	yd³	
Ot	her Cost 1: her Cost 2: her Cost 3:			m³ _	yd³	

File Analyzed By: PD ____ Date: 10/26/2006 ____Other: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents X Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: _____ Type of Site: Non-DOD ___ DoD Facility Name: Former Chemcial Manufacturing Facility Address: City, State, Zip Code: Brooklynn, NY OU# or Site #: _ Primary point of contact: Todd M. Musterait Organization: Environmental Strategies Consulting LLC Address: 70 Graystone Lane City, State, Zip Code: Orchard Park, NY 14127 Phone #: 716-662-5128 email: tmusterait@esc-ny.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0635

General Site Information

Gen	neral Site Assessment Data Facility ID#: 0635										
X	Impacted .	x Impacted zone a	w direction)(ft.): <u>below</u> as defined by documentation ood for determining size of im			ness (ft):	_	Unknown			
	_ Monitor V	Vells: Number of relevant m	nonitoring wells with groundy	vater data:				None			
		Number of wells relat Pre-treatment Post-treatment		ssgradient:ssgradient:							
_	Soil Boring	s: Number of relevant so	oil borings with pre-treatment	data:							
		Number of relevant so	oil borings with post-treatmen	t data:							
		Number inside treatme	ent zone:	Number outside	treatment zone:						
X	Types of C	Contaminants									
					Average Pre-treatme	ent Concentration per nical:		nent Concentration per mical:			
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
		x Trichloroethene	Hexane	Creosote	None	None	None	None			
	-	x Tetrachloroethene	Jet Fuel		None	None	None	None			
		1,1-dichloroethene	x Napthalene		None	None	None	None			
		cis-1,2-dichloroethene	x Benzene		None	None	None	None			
		trans-1,2-dichloroethene	x Tolune		None	None	None	None			
		1,1-dichloroethane	Ethylbenzene		None	None	None	None			
		1,2-dichloroethane	m/p-xylene		None	None	None	None			
		1,1,1-trichloroethane	o-xylene		None	None	None	None			
	emicals of Concern	1,1,2-trichloroethane	x phenol		None	None	None	None			
Ì	501100111	1,1,2,2-tetrachloroethane	x xylenes		None	None	None	None			
		Vinyl Chloride			None	None	None	None			
		X acetone			None	None	None	None			
		x methylene chloride			None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
				<u> </u>	Hone	Hone	None	Tronc			
	Comme	nts:		<u>1.6 acre</u>	es - impacted						
	Attachmen	its:									

Hydrogeologic Conceptual Model Facility ID#: 0635 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone __ Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments __ Largely permeable sediments with inter-bedded lenses of lower permeability material _Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) _ Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _ Unknown _ Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: _ Flow direction _ Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: ___ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory __ Field data low ____ Unknown

high

Comments:

The	ermal Treatment - Design				Fa	acility ID#: 0635
<u>x</u>	Thermal treatment:	Conduc	ctive			
_		Electric	cal Resistance			
		_	3 phase	6 phase	AC power	DC power
		x Steam	<u>Pilot</u>			
		_	Steam	Steam + air	Steam + O2	
		Other (describe)			
<u>x</u>	Type of Test: <u>x</u>	Pilot test	Full-scale	System		
	_ Geology of Treatment Zor	ne: _	Relatively hom	ogeneous and permeable	unconsolidated s	ediments
		_	Relatively hom	ogeneous and impermeal	ble unconsolidated	I sediments
		_	Largely perme	able sediments with inter-	bedded lenses of I	ower permeability material
		_	Largely impern	neable sediments with inte	er-bedded layers o	f higher permeability material
		_	Competent, bu	t fractured bedrock (i.e. c	rystalline rock)	
		_	Weathered bed	drock, limestone, sandsto	ne	
	_ Treatment Targe Zone:	Satura	ted only	Vadose only	Both (Saturate	d and Vadose zones)
	_ Start of Thermal Test:			Duration:		
	_ Hydraulic Control	Yes	No			
	_ Treatment Cell Design:					
	Size of target zone (ft2):				Unknow	rn (<u>x</u> ft)
	Thickness of target zone ((ft):			Unknow	m
	Depth to top of target zone	e (ft bgs):			Unknow	m
	Thickness of target zone I	below water tab	ole (ft):		Unknow	n
	Number of energy deliver	y points:			Unknow	n
	Number of extraction poin	ıts:			Unknow	m
	_ Temperature Profile:					
	Initial formation temperatu	ure (deg C):				Unknown
	Maximum representative	formation temp	erature (deg C):			Unknown
	Time to reach maximum r	epresentative t	emperature (days):			Unknown
	Duration of treatment at re	epresentative to	emperature (days):			Unknown
				<u>Date</u>		Temperature (deg C)
	Formation temperature im	mediately post	-treatment:			
	Formation temperature po	ost-treatment m	onitoring event 1:	-		
	Duration of post-treatmen	t monitoring (da	ays):			
	_ Mass of contaminant remo					
	Via	ı liquid pumpinç	j:		lb	kg Unknown
	In v	vapor stream:			lb	kg Unknown
	Tot	tal:			lb	kgUnknown
	Comments:					
	Attachments:					
						-

t and Performance					Facility ID#	0635
_ Performance						
Remediation Goal:	_					
Ir	n Groundwater: -					
Ir	n Soil:					
Was the Remediation G						
Ir	n Groundwater					
	Comment: —					
	_					
Ir	_					
	Comment: —					
	_					
General comments on the	he thermal applica	ation:				
Lessons Learned						
-						
_ Energy						
Total Energy Used:			kWhr	kWhr/	m³	kWhr/yd ³
	energy applied to t	reatment zone:	<u> </u>		kWhr/m ³	kWhr/y
Other e					kWhr/m ³	kWhr/y
		note other energy:				
	1 10000					
		07				
Cost		5,				
Cost Total Project Cost:						
Total Project Cost:						
Total Project Cost: Consul	Itant Cost:					
Total Project Cost: Consul	al Vendor Cost:			_ m³	yd³	
Total Project Cost: Consul Therm: Energy	al Vendor Cost: / Cost:			_ m³	yd³	
Total Project Cost: Consul Therma	al Vendor Cost: / Cost: Cost 1:			_ m³	yd³	
Total Project Cost: Consul Therm: Energy Other 0	al Vendor Cost: / Cost: Cost 1: Cost 2:			_ m³ _	yd³	
Total Project Cost: Consul Therma	al Vendor Cost: / Cost: Cost 1: Cost 2: Cost 3:	Other Cost 1:		_ m³ _	yd³	

_ Other Cost 3:

File Analyzed By: PD ____ Date: 10/26/2006 ____Other: Type of treatment: _Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents X Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: Jul-04 End of Test: _____ Duration: _____ Type of Site: Non-DOD _ DoD Facility Name: Former Chemcial Manufacturing Facility Address: City, State, Zip Code: Brooklynn, NY OU# or Site #: Primary point of contact: Todd M. Musterait Organization: Environmental Strategies Consulting LLC Address: 70 Graystone Lane City, State, Zip Code: Orchard Park, NY 14127 Phone #: 716-662-5128 email: tmusterait@esc-ny.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0638

General Site Information

Gener	neral Site Assessment Data Facility ID#: 0638										
<u>x</u>	Impacted :	x Impacted zone a	-	Width (ft):		ness (ft):	_	Unknown			
	Monitor V	Vells: Number of relevant m	nonitoring wells with grounds	vater data:				None			
		Number of wells relat Pre-treatment Post-treatment	Downgradient:		ssgradient:ssgradient:						
	Soil Boring	s: Number of relevant so	il borings with pre-treatment	data:							
		Number of relevant so	il borings with post-treatmen	nt data:							
		Number inside treatme	ent zone:	Number outside	treatment zone:						
<u>x</u>	Types of C	Contaminants									
					Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:			
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
		x Trichloroethene	Hexane	Creosote	None	None	None	None			
		x Tetrachloroethene	Jet Fuel		None	None	None	None			
	-	1,1-dichloroethene	x Napthalene		None	None	None	None			
		cis-1,2-dichloroethene	x Benzene		None	None	None	None			
		trans-1,2-dichloroethene	x Tolune		None	None	None	None			
		1,1-dichloroethane	Ethylbenzene		None	None	None	None			
		1,2-dichloroethane	m/p-xylene		None	None	None	None			
		1,1,1-trichloroethane	o-xylene		None	None	None	None			
	micals of oncern	1,1,2-trichloroethane	x phenol		None	None	None	None			
	Jiloeili		x xylenes		None	None	None	None			
		Vinyl Chloride			None	None	None	None			
		X acetone			None	None	None	None			
		x methylene chloride			None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
<u> </u>					None	None	None	rone			
	Comme			<u>1.6 acre</u>	es - impacted						
,	Attachmen	its:									

Hydr	rogeologic Conceptual	Model					Facility ID#:	0638
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated					
		Vadose Zone:	Relatively	homogeneous a	ınd permeable uı	nconsolidated sedi	iments	
			Relatively	homogeneous a	and impermeable	unconsolidated se	ediments	
			x Largely pe	rmeable sedime	ents with inter-be	dded lenses of low	er permeabilit	y material
			Largely im	permeable sedir	ments with inter-	bedded layers of h	igher permeat	oility material
			Competen	t, but fractured b	edrock (i.e. crys	talline rock)		
			Weathered	d bedrock, limes	tone, sandstone			
		Saturated Zone:	Relatively	homogeneous a	ınd permeable uı	nconsolidated sedi	iments	
			Relatively	homogeneous a	and impermeable	unconsolidated se	ediments	
			Largely pe	rmeable sedime	ents with inter-be	dded lenses of low	er permeabilit	y material
			Largely im	permeable sedir	ments with inter-	bedded layers of h	igher permeat	oility material
			Competen	t, but fractured b	edrock (i.e. crys	talline rock)		
			Weathered	d bedrock, limes	tone, sandstone			
	Aquifer Characteristic Is more than 1 aquife Depth to water:		No Aquifer 1	Yes (number):	juifer 2	Unk Aquifer 3	known (assume :	single aquifer)
	Flow direction							
	_ Horizontal hydraulic g	radient (feet/foot):					1	Unknown
	Vertical hydraulic grad	, , ,						Unknown
	, ,	,						
	_K range (ft/day)	Measured	using:	Slug Test	Laborato	ry	Field data	
-	- • • • • • • • • • • • • • • • • • • •	low						Unknown
		high						
	Transmissivity (ft2/da	_	usina:	Slug Test	Laborato	rv	Field data	
		low	<u> </u>			_	_	Unknown
		high		-				
		9						

Comments:

The	ermal Treatment - Design							Facility ID#:	<u>0638</u>
<u>x</u>	Thermal treatment:		_ Conducti	ve					
			_ Electrical	Resistance					
			_	3 phase		6 phase	AC pov	verDC	power
		<u>x</u>	Steam	<u>Full</u>					
				Steam		Steam + air	Steam +	- O2	
			Other (de	scribe)					
<u>x</u>	Type of Test:	Pilo	t test	<u>x</u> Full-	scale System	1			
	_ Geology of Treatment Zor	ne:		Relatively	homogene	ous and permea	able unconsolid	ated sediments	
				Relatively	homogene	ous and imperm	neable unconso	lidated sediments	
				Largely pe	ermeable se	ediments with in	ter-bedded lens	es of lower perme	ability material
				Largely im	npermeable	sediments with	inter-bedded la	yers of higher perr	neability material
				Competer	nt, but fractu	ired bedrock (i.e	e. crystalline roo	ck)	
				Weathere	d bedrock,	imestone, sand	stone		
	_ Treatment Targe Zone:		_ Saturate	d only	Vado	ose only	Both (S	aturated and Vadose	zones)
	_ Start of Thermal Test:	Jul-(04			Duration	:		
	_ Hydraulic Control		_ Yes	No					
<u>X</u>	Treatment Cell Design:								
	Size of target zone (ft2):						U	nknown (_ x ft)
	Thickness of target zone ((ft):					U	nknown	
	Depth to top of target zon	e (ft bo	gs):				U	nknown	
	Thickness of target zone I	below	water table	e (ft):			U	nknown	
	Number of energy delivery	y point	s:		<u>47</u>		u	nknown	
	Number of extraction poin	its:			<u>44</u>		U	nknown	
	_ Temperature Profile:								
	Initial formation temperatu	ıre (de	g C):					Unknowr	1
	Maximum representative t			ature (deg C):			Unknowr	
	Time to reach maximum r		-					Unknowr	1
	Duration of treatment at re				-		_	Unknowr	
					,			· 	
						<u>Da</u>	<u>ite</u>	Temperatu	re (deg C)
	Formation temperature im	media	tely post-ti	reatment:					
	Formation temperature po	st-trea	atment moi	nitoring even	t 1:				
	Duration of post-treatmen	t monit	toring (day	s):					
	_ Mass of contaminant remo	oved:							
	Via	liquid	pumping:				lb	kg	Unknow
	In v	apor s	stream:		-		lb	kg	Unknow
	Tot	tal:					lb	kg	Unknow
	Comments:								
	Attachments:								
	-								

and Performance					Facility ID#:	<u>0638</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	<u> </u>					
	In Soil:					
Was the Remediation						
	Comment: —					
	<u> </u>					
	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Whr/yd ³
To	tal energy applied to to	reatment zone:			_kWhr/m ³	kWhr/yd
	her energy:				_ kWhr/m³	kWhr/yd
		note other energy:				
	110000	note enter energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
Th	ermal Vendor Cost:					
En	ergy Cost:			m ³	_ yd³	
	her Cost 1:				_ , -	
	her Cost 2:	-				
	her Cost 3:					
Please note or		Other Cost 1:				
i lease flote 0						
		Other Cost 2:				

____ Other Cost 3:

<u>x</u> File Analyzed By: J	JT <u>x</u> PD			Date:	5/11/2005
Type of treatment:	Conductive	Steam	x ERH Other:		
Type of Contaminant:	<u>x</u> Chlorinated Solv	vents <u>x</u>	Petroleum Hydrocarbons	Pesticides	
	Wood Treating		Other:		
Treatment Status:	Active	$\underline{\mathbf{x}}$ Post			
Type of Test:	Pilot Test	x Full Scale	e System		
Start of Test:	8/26/1996	End	of Test: <u>9/25/1996</u>	Duration: 30 d	
Type of Site:	Non-DOD	<u>x</u> DoD			
	a Falls International Airport	Air Reserve			
Address: City, State, Zip Code:	Niagara Falls, NY				-
OU# or Site #: Site 10	-				
Y Primary point of contact:	•				
Organization: Air Re					
Address: 2405 Frankli					
City, State, Zip Code:	Niagara Falls, NY 143				
Phone #: <u>716-236-312</u>	<u>6</u>	email: ger	ald.hromowyk@niagarafalls.af.mi	<u>l</u>	
Other contacts or vendors	s who worked on site		None		
Point of contact:					
Type:Vendor	r, Consultant	_ Vendor, Techni	cal Applications(Other	
Organization:					
Address:					
City, State, Zip Code:					
Phone #:		email:			
QA/QC					
Characteristics of Inter-	est				
Good pre- and post	t-treatment groundwater data	a	Good pre- and post-treatr	ment soil data	
Good temperature	profile vs. time information		Flux assessment		
Groundwater eleva	tions		Geologic cross-section		
Hydraulic Conduct	ivity information				

Facility ID#:

0640

General Site Information

Impacted Zone:						Facility II	D#: <u>0640</u>
	Length (parallel to fl	low direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
	= "	e as defined by documentation					
		ethod for determining size of in		ne definition attachmer	nts)		
	Map attachme	-			,		
	 .						
x Monitor Wells:	Number of relevant	t monitoring wells with ground	water data:				None
			Pre-treatment:		Post-treatment:	<u>13</u>	
	Number of wells rel	lative to treatment zone:					
	Pre-treatmen	nt In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatmer		Upgradient:	Downgradient:	<u>13</u> Cros	ssgradient:	
x Soil Borings:	Number of relevant	soil borings with pre-treatmen	t data: <u>15</u>				
	Number of relevant	soil borings with post-treatment	nt data: <u>15</u>				
	Number inside treat	ment zone: 15	Number outside	treatment zone:	<u>15</u>		
x Types of Contamir	nants						
				Avaraga Pra traatm	ent Concentration per	Avaraga Post treatm	ent Concentration per
					nical:		nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
<u>x</u> T	richloroethene	Hexane	Creosote	None	1 mg/kg	None	1 mg/kg
<u>x</u> T	etrachloroethene	Jet Fuel		None	0.01 mg/kg	None	0.05 mg/kg
1,	,1-dichloroethene	Napthalene		None	None	None	None
ci	s-1,2-dichloroethene	x Benzene		None	0.01 mg/kg	None	0.01 mg/kg
<u>x</u> tr	ans-1,2-dichloroethene	Tolune		None	0.05 mg/kg	None	0.01 mg/kg
1,	,1-dichloroethane	<u>x</u> Ethylbenzene		None	0.5 mg/kg	None	0.5 mg/kg
1,	2-dichloroethane	x m/p-xylene		None	0.5 mg/kg	None	0.1 mg/kg
Chemicals of1,	1,1-trichloroethane	x o-xylene		None	0.05 mg/kg	None	0.05 mg/kg
	1,2-trichloroethane	x <u>Tolune</u>		None	0.01 mg/kg	None	0.01 mg/kg
1.	1,2,2-tetrachloroethane	x MEK (2-butanone)		None	0.05 mg/kg	None	0.1 mg/kg
v	inyl Chloride	x acetone		None	0.5 mg/kg	None	0.1 mg/kg
<u>x</u> <u>cl</u>	nloroform			None	0.01 mg/kg	None	0.01 mg/kg
		x carbon disulfide		None	0.01 mg/kg	None	0.05 mg/kg
		x methylene chloride		None	0.1 mg/kg	None	0.5 mg/kg
		F -					
				None	None	None	None
				None None	None None	None None	None None

<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			x Largely permeable sediments with inter-bedded lenses of lower permeability material
			Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments
			Relatively homogeneous and impermeable unconsolidated sediments
			\underline{x} Largely permeable sediments with inter-bedded lenses of lower permeability material
			Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
	_ Ground surface eleva	ation based on wells in o	adjacent to treatment zone: ft amsl Unknown
<u>x</u>	Aquifer Characteristic	os:	
	Is more than 1 aquife	r present?	No Yes (number): <u>X</u> Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3
	Depth to water:	low value (ft bgs):	2.5
		high value (ft bgs):	
		Unknown:	
	Flow direction		
	_ Horizontal hydraulic g	gradient (feet/foot):	Unknown
	Vertical hydraulic gra	dient (feet/foot):	Unknown
<u>x</u>	K range (ft/day)	Measured	using: Slug Test Laboratory Field data
		low	<u>0.85</u> Unknown
		high	
	Transmissivity (ft2/da	y): Measured	using: Slug Test Laboratory Field data
		low	Unknown
		high	
	Comments:		
	<u> </u>		
	Attachments:		

Facility ID#:

0640

Hydrogeologic Conceptual Model

The	rmal Treatment - Design								Facility ID#	: 064	<u>0</u>
<u>x</u>	Thermal treatment:	c	Conductive								
		<u>x</u> E	lectrical R	esistance							
				3 phase	<u>x</u>	6 phase		AC power		DC power	
		s	team	Steam	_	Steam +	air	Steam + C)2		
		c	ther (descr	ribe)							
<u>x</u>	Type of Test:	Pilot tes	st	<u>x</u> Full-	scale Sys	tem					
<u>x</u>	Geology of Treatment Zone	e:		Relatively	homoge	eneous and p	ermeable u	nconsolidate	ed sediments		
				Relatively	homoge	eneous and i	mpermeable	unconsolid	ated sedimen	ts	
			<u>x</u>	Largely pe	ermeable	e sediments	with inter-be	dded lenses	of lower peri	meability i	material
				Largely im	npermea	ble sedimen	ts with inter-	bedded laye	ers of higher p	ermeabili	ty material
				Competer	nt, but fra	actured bedro	ock (i.e. crys	stalline rock)			
				Weathere	d bedroo	k, limestone	, sandstone				
<u>X</u>	Treatment Targe Zone:	s	Saturated	only	v	adose only	<u>X</u>	Both (Satu	rated and Vad	ose zones)	
<u>X</u>	Start of Thermal Test:	8/26/19	<u>96</u>			Dι	uration: 330	<u>) d</u>			
<u>x</u>	Hydraulic Control	<u>x</u> Y	res	No							
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):				9500			Unk	nown (<u>110</u> x	<u>110</u> ft)
	Thickness of target zone (ft	t):			9			Unk	nown		
	Depth to top of target zone	(ft bgs):			<u>1</u>			Unk	inown		
	Thickness of target zone be	elow wat	ter table (f	ft):	<u>7.5</u>			Unk	nown		
	Number of energy delivery	points:			<u>29</u>			Unk	nown		
	Number of extraction points	3:			<u>5</u>			Unk	nown		
<u>x</u>	Temperature Profile:										
	Initial formation temperature	e (deg C	;):			<u>15</u>			Unkno	own	
	Maximum representative for	rmation	temperat	ure (deg C):	<u>82</u>			Unkno	own	
	Time to reach maximum re	presenta	ative temp	erature (da	ays):	<u>25</u>			Unkno	own	
	Duration of treatment at rep	oresenta	tive temp	erature (da	ays):	<u>5</u>			Unkno	own	
							<u>Date</u>		Temper	ature (deg	<u>1 C)</u>
	Formation temperature imn	nediately	post-trea	atment:		9/25/199	<u>6</u>		<u>75</u>		
	Formation temperature pos	t-treatm	ent monit	oring even	t 1:	10/15/19	<u>96</u>		<u>40</u>		
	Duration of post-treatment	monitori	ng (days):	:							
<u>x</u>	Mass of contaminant remov	ved:									
_	Via I	iquid pu	mping:					lb	kg		Unknow
	In va	apor stre	am:					lb	kg		Unknow
	Tota	l:			<u>6</u>	<u>54.3</u>		lb	<u>x</u> kg		_ Unknow
	Comments:										
	Attachments:										

Cos	st and Performance					Facility ID#:	<u>0640</u>
	_ Performance						
	Remediation Goal:						
		In Groundwater: —					
		_					
		_ In Soil:					
	Was the Remediation						
		_ In Groundwater					
		Comment: —					
		_					
		_ In Soil					
		Comment: —					
		_					
	General comments o	n the thermal applica	tion:				
	Objective: Red	luce VOC concentrati	ons in the saturated	and unsatured soils	at site 10		
	Lessons Learned						
							_
v	Enorgy						
<u>x</u>	Energy	336000		x kWhr	kWhr/m	3 kW	/br/vd ³
	Total Energy Used:	336000		<u>x</u> kWhr 140000 kWhr	KVVIII/III	kWhr/m ³	kWhr/yd ³
		al energy applied to tr	earment zone:	140000 KWIII		kwni/m kWhr/m³	kWhr/yd ³
	Oth	er energy:				KVVIII/III	KVVIII/yd
		Please i	note other energy:				
	_ Cost						
	Total Project Cost:						
	Con	sultant Cost:					
	The	rmal Vendor Cost:					
		rgy Cost:			m³	yd³	
	· 	er Cost 1:			_	•	
		er Cost 2:		<u> </u>			
	· 	er Cost 3:					
	Oth		Other Cost 1:				
			Other Cost 2:				
		_	Other Cost 2:				

File Analyzed By: PD ____ Date: 10/30/2006 JT X ____Steam ____ERH Type of treatment: Conductive Type of Contaminant: _____Pesticides Chlorinated Solvents _____Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: 6 months Nov-06 Type of Site: ___Non-DOD __ DoD Facility Name: Syracus, NY Address: City, State, Zip Code: Syracuse, NY OU# or Site #: Primary point of contact: Gorm Heron Organization: TerraTherm Address: 10 Stevens Road City, State, Zip Code: Fitchburg, MA 01420 Phone #: 978-343-0300 email: gheron@terratherm.com Other contacts or vendors who worked on site ____None Point of contact: _____Vendor, Technical Applications Type: Vendor, Consultant Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest ___ Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0645

General Site Information

Y Impacted Zone: Length (parallel to flow direction)(ft.): Width (ft): Thickness (ft): 20 Unknow Impacted zone as defined by documentation Alternative method for determining size of impacted zone (See source zone definition attachments)	n
Monitor Wells: Number of relevant monitoring wells with groundwater data: None Pre-treatment: Post-treatment: Number of wells relative to treatment zone:	
Pre-treatment In: Upgradient: Downgradient: Crossgradient:	
Post-treatment In: Upgradient: Downgradient: Crossgradient:	
X Soil Borings: Number of relevant soil borings with pre-treatment data: more than 30 Number of relevant soil borings with post-treatment data: 30 Number inside treatment zone: 30 Number outside treatment zone: 0 Types of Contaminants	
Average Pre-treatment Concentration per Average Post-treatment Concentration Chemical: Chemical:	n per
Chlorinated Solvents Petroleum Hydrocarbons Other Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L) Soil (mg/	kg)
<u>x</u> Trichloroethene <u>Hexane Creosote</u> None None None None	
<u>x</u> Tetrachloroethene	
<u>x</u> cis-1,2-dichloroethene <u>Benzene</u> <u>None</u> <u>None</u> <u>None</u> <u>None</u> <u>None</u>	
trans-1,2-dichloroetheneToluneNone None None None None	
Chemicals of Concern 1,1,2-trichloroethane None None None None	
∑	
None None None None	

Comments:

 $\underline{\text{See IRM Work Plan and final report when it becomes available. Treating 3 source zones totalling 16,200 cubic yards, avg. depth 20 \, ft}$

Attachments:

Map showing 3 DNAPL treatment zones

<u>x</u>	Horizontal hydraulic gradient (feet/fo	•	0.003 unknown				Unknown
<u>x</u>	K range (ft/day)	Measured	•	<u>x</u>	Slug Test	Laboratory	Field data Unknown
		IOW	0.1				Unknown
		high	<u>1</u>				
	Transmissivity (ft2/day):	Measured	l using:		Slug Test	Laboratory	Field data
		low					Unknown
		high					

The	rmal Treatment - Design						Facility ID#:	<u>0645</u>	
<u>x</u>	Thermal treatment:	<u>x</u> Cond	ductive						
		Elec	trical Resistance						
			3 phase		_ 6 phase	AC power	DC	power	
		Stear	m Steam		_ Steam + air	Steam + C)2		
		Othe	er (describe)				_		
<u>x</u>	Type of Test:	Pilot test		l-scale Syster	n				
<u>x</u>	Geology of Treatment Zone	- e:	=	y homogene	eous and permeal	ble unconsolidate	ed sediments		
_				-	eous and imperme				
				-	ediments with inte			ability material	
							·	meability material	
			Compete	ent, but fract	ured bedrock (i.e.	. crystalline rock)			
			Weather	ed bedrock,	limestone, sands	stone			
<u>x</u>	Treatment Targe Zone:	Satı	rated only	Vad	lose only	x Both (Satu	rated and Vadose	zones)	
<u>x</u>	Start of Thermal Test:	Nov-06			Duration:	6 months			
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No						
<u>x</u>	Treatment Cell Design:								
	Size of target zone (ft2):			21870		Unk	nown (_ x ft)	
	Thickness of target zone (f	t):		18-27		Unk	nown		
	Depth to top of target zone	(ft bgs):		<u>0</u>		Unk	nown		
	Thickness of target zone b	elow water	table (ft):	<u>17-24</u>		Unk	nown		
	Number of energy delivery	points:		<u>211</u>		Unk	nown		
	Number of extraction points	s:		17 horizor	ntal collectors	Unk	nown		
<u>x</u>	Temperature Profile:								
	Initial formation temperatur	re (deg C):			<u>10</u>		Unknow	ı	
	Maximum representative for	ormation ter	mperature (deg (C):	<u>110</u>		Unknown		
	Time to reach maximum re	presentativ	e temperature (d	days):	<u>200</u>		Unknown		
	Duration of treatment at re	presentative	e temperature (d	lays):	<u>60</u>		Unknow	1	
					<u>Dat</u>	<u>e</u>	Temperatu	re (deg C)	
	Formation temperature imr	nediately po	ost-treatment:						
	Formation temperature pos	st-treatment	monitoring ever	nt 1:					
	Duration of post-treatment	monitoring	(days):						
	_ Mass of contaminant remo	ved:							
	Via	liquid pump	ing:			lb	kg	Unknown	
	In va	apor stream	: <u> </u>			lb	kg	Unknown	
	Tota	al:	_			lb	kg	Unknown	
	Comments:								
	Attachments:								

Cost and Performance Facility ID#: 0645

Performance		
Remediation Goal:		
In Ground	water: ———	
<u>x</u> In Soil:	5.600 μg/kg for PCE; 2,800 μ	μg/kg for TCE: 1,200 μg/kg for trans-1,1-dichloroethene; and 800 μ for vinyl chloride
Was the Remediation Goal Achie	eved:	
In Ground		
	iment:	
In Soil		
	iment:	
General comments on the therma	al application:	
	_	
Lessons Learned		
-		
_ Energy		
Total Energy Used:		kWhr kWhr/m³ kWhr/yd³
	plied to treatment zone:	kWhr/m ³ kWhr
Other energy:	_	kWhr/m ³ kWhr
	Please note other energy:	<u> </u>
Cost		
Total Project Cost:		
Consultant Cos	<u> </u>	
Thermal Vendo	Cost:	
Energy Cost:		m ³ yd ³
Other Cost 1:		
Other Cost 2:		
Other Cost 3:		
Please note other cost:	Other Cost 1:	
-	Other Cost 2:	
	Other Cost 3:	

PD ____ File Analyzed By: Date: 4/12/2005 Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: Jul-98 End of Test: Aug-99 Duration: ~1 year Type of Site: ___Non-DOD _ DoD Facility Name: <u>DOE Portsmouth Gaseous Diffusion Facility</u> Address: City, State, Zip Code: Ohio OU# or Site #: Primary point of contact: Sandy Childer Organization: Address: City, State, Zip Code: Phone #: 740-897-2336 email: y84@bechtel.jacobs.org Other contacts or vendors who worked on site _ None Point of contact: John Sokol Type: _ Vendor, Consultant _____ Vendor, Technical Applications Other Organization: Bechtel-Jacobs Address: City, State, Zip Code: <u>OH</u> Phone #: _____ email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0660

General Site Information

x Impacted		w direction)(ft.): 2080 as defined by documentation	Width (ft):	Thick	ness (ft):		Unknown		
	Alternative method for determining size of impacted zone (See source zone definition attachments)								
	Map attachment	Map attachment							
<u>x</u> Monitor V	_								
	North and formula and a	Pre-treatment: <u>6</u> Post-treatment: <u>6</u> Number of wells relative to treatment zone:							
	Pre-treatment	In: 6	Downgradient: Crossgradient:						
	Post-treatment	-	Upgradient:			ssgradient:			
	i ost-treatment	III. <u>0</u>	opgradient.	Downgradient.		ssgradient.			
Soil Boring		Number of relevant soil borings with pre-treatment data:							
		Number of relevant soil borings with post-treatment data:							
	Number inside treatme	ent zone:	_ Number outside	e treatment zone:					
Types of C	Contaminants			Average Pre-treatment Concentration per Chemical:		Average Post-treatment Concentration per Chemical:			
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)		
	Trichloroethene	Hexane	Creosote	None	None	None	None		
	Tetrachloroethene	Jet Fuel		None	None	None	None		
	1,1-dichloroethene	Napthalene		None	None	None	None		
	cis-1,2-dichloroethene	Benzene		None	None	None	None		
	trans-1,2-dichloroethene	Tolune		None	None	None	None		
	1,1-dichloroethane	Ethylbenzene		None	None	None	None		
	1,2-dichloroethane	m/p-xylene		None	None	None	None		
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None		
Concern	1,1,2-trichloroethane			None	None	None	None		
	1,1,2,2-tetrachloroethane			None	None	None	None		
	Vinyl Chloride			None	None	None	None		
				None	None	None	None		
				None	None	None	None		
				None	None	None	None		
				None	None	None	None		
				None	None	None	None		
				None	None	None	None		
Comme									
Comme	nis.								
Attachmen	nts:								
				<u> </u>		_			

Facility ID#:

0660

General Site Assessment Data

Hyd	rogeologic Conceptua	al Model		Facility ID#: 0660					
<u>x</u>	Geology:	Zone	<u>Unconsolidated Sediments</u>						
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments						
			x Relatively homogeneous and impermeable unconsolidated	I sediments					
			Largely permeable sediments with inter-bedded lenses of lower permeability material						
			Largely impermeable sediments with inter-bedded layers of higher permeability material						
			Competent, but fractured bedrock (i.e. crystalline rock)						
			Weathered bedrock, limestone, sandstone						
		Saturated Zone:	ed Zone: Relatively homogeneous and permeable unconsolidated sediment						
			Relatively homogeneous and impermeable unconsolidated sediments						
		x Largely permeable sediments with inter-bedded lenses of I	ower permeability material						
			Largely impermeable sediments with inter-bedded layers of higher permeability material						
			Competent, but fractured bedrock (i.e. crystalline rock)						
			Weathered bedrock, limestone, sandstone						
<u>x</u>	Ground surface ele	vation based on wells in o	adjacent to treatment zone: ft amsl	<u>x</u> Unknown					
<u>x</u>	Aquifer Characteris	tics:							
	Is more than 1 aquifer present?		No Yes (number): <u>x</u> U	Unknown (assume single aquifer)					
			Aquifer 1 Aquifer 2 Aquifer 3						
	Depth to water:	low value (ft bgs):		_					
		high value (ft bgs):	<u></u>	_					
		Unknown:		_					
<u>x</u>	Flow direction		<u> </u>	_					
<u>x</u>	Horizontal hydraulic	gradient (feet/foot):		<u>x</u> Unknown					
	Vertical hydraulic gradient (feet/foot):			<u>x</u> Unknown					
<u>x</u>	K range (ft/day)	Measured	ising: Slug Test Laboratory	Field data					
~	rrange (waay)	low		riou data X Unknown					
		high							
	Transmissivity (ft2/d	· ·	sing: Slug Test Laboratory	Field data					
	, ,	low							
		high							
		3		_					
	Comments:								
	<u>in</u> :	trinsic permeability = 5 o	arcy (5e-3 cm/s)						

The	rmal Treatment - Design						Facility ID#:	0660	
<u>x</u>	Thermal treatment:	Conductive	e						
		Electrical I	Resistance						
			_ 3 phase		6 phase	AC powe	er Do	power	
		x Steam	DUS/HPO						
			Steam	<u>x</u>	Steam + air	Steam +	02		
		Other (desc	cribe)						
<u>x</u>	Type of Test: <u>x</u>	Pilot test	Full-s	scale Systen	ı				
<u>x</u>	Geology of Treatment Zon	e:	_ Relatively I	homogene	ous and permea	able unconsolidat	ted sediments		
			_ Relatively I	homogene	ous and impern	neable unconsoli	dated sediments		
		<u>x</u>	Largely pe	rmeable se	ediments with in	ter-bedded lense	s of lower perme	ability ma	aterial
			_ Largely im	permeable	sediments with	inter-bedded lay	ers of higher per	meability	material
			_ Competent	t, but fractu	ured bedrock (i.e	e. crystalline rock)		
			_ Weathered	d bedrock,	limestone, sand	Istone			
	_Treatment Targe Zone:	Saturated	only	Vado	ose only	Both (Sat	urated and Vados	zones)	
<u>x</u>	Start of Thermal Test:	<u>Jul-98</u>			Duration	: <u>~1year</u>			
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No						
<u>x</u>	Treatment Cell Design:								
	Size of target zone (ft2):			<u>17000</u>		Un	known (<u>1</u>	<u>80</u> x	<u>120</u> ft)
	Thickness of target zone (f	ft):		<u>35</u>		Un	known		
	Depth to top of target zone	(ft bgs):				<u>x</u> Un	known		
	Thickness of target zone b	elow water table	(ft):	<u>20</u>		Un	known		
	Number of energy delivery	points:		<u>19</u>		Un	known		
	Number of extraction point	ts:		7		Un	known		
<u>x</u>	Temperature Profile:								
=	Initial formation temperatur	re (dea C):			18		Unknow	n	
	Maximum representative for		ture (dea C)	:	100		Unknow		
	Time to reach maximum representative temperature (day				112		Unknow		
	Duration of treatment at re						<u>C</u> Unknow		
		F		, -,-				-	
					<u>Da</u>	<u>ite</u>	Temperatu	ıre (deg C	<u>C)</u>
	Formation temperature imi	mediately post-tre	atment:						
	Formation temperature post-treatment monitoring event 1:			1:					
	Duration of post-treatment	monitoring (days):						
<u>x</u>	Mass of contaminant remo	oved:							
_	Via	liquid pumping:				lb	kg	<u>x</u>	Unknow
	In v	apor stream:				lb	kg	<u>x</u>	Unknow
	Tota	al:		400		lb	kg		Unknow
	Comments:								
	Attachments:								

Cost and Performance					Facility ID#:	<u>0660</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	<u> </u>					
	In Soil:					
Was the Remediation	on Coal Ashiovad					
	_ In Groundwater _ Comment: -					
	Comment					
	In Soil					
	Comment:					
	-					
	=					
General comments	on the thermal applic	cation:				
SteamTech (v	endor) published a fi	nal report with DOE as [Document no. DO	E/OR/11-3032, bu	it I could not obta	ain this document.
Lessons Learned						
						_
Energy						
Total Energy Used:			l/W/hr	kWhr/m ³	۲۱۸۸	/br/vd ³
		Arantmant zana.	KWIII		kWhr/m ³	kWhr/yd ³
	tal energy applied to	realment zone:			_ kWhr/m ³	
Otr	ner energy:	_			_ KVVNr/m	kWhr/yd ³
	Please	e note other energy:				
Cost						
Total Project Cost:		>1,000,000				
Co	nsultant Cost:					
	ermal Vendor Cost:					
	ergy Cost:			m^3	_ yd³	
	ner Cost 1:				_ /=	
	ner Cost 1:					
· 						
· 	ner Cost 3:	Other Cast 1:				
Please note of	mer cost:	Other Cost 1:				
	_	Other Cost 2:				
	_	Other Cost 3:				

Facility ID#: 0670 PD ____ File Analyzed By: Date: 10/18/2006 Type of treatment: ___ Conductive ____ Steam <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ___ Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: End of Test: <u>11/20/1998</u> 10/19/1998 Duration: 42 d Type of Site: Non-DOD __ DoD Facility Name: Confidential Midwest Address: City, State, Zip Code: Ohio OU# or Site #: Primary point of contact: Mark Lyverse Organization: Address: City, State, Zip Code: Phone #: email: ___ Other contacts or vendors who worked on site __ None Point of contact: Type: Vendor, Consultant Vendor, Technical Applications ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

General Site Information

___ Hydraulic Conductivity information

General Site As	sessment Data					Facility I	D#: <u>0670</u>
Impacted	Zone: Length (parallel to flov	v direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
	Impacted zone a	as defined by documentation					
		od for determining size of im		one definition attachmen	nts)		
	Map attachment	=	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		·· ·· /		
	map attacriment						
Monitor V	Malla. North an afficiation at a						N.
IVIORITOI V	veils. Number of relevant if	nonitoring wells with grounds			5		None
			Pre-treatment:		Post-treatment:		
		tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:				
	Number of relevant so	oil borings with post-treatmer	nt data:				
	Number inside treatme	ent zone:	_ Number outside	e treatment zone:			
x Types of C	Contaminants						
_ //							
				Average Pre-treatme	ent Concentration per		nent Concentration per mical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None None	None
			Creosote				
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	x Benzene		0.5 mg/L	5 mg/kg	0.005 mg/L	0.05 mg/kg
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Ob and all of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	-4						
Comme	nts.						
			Estimated 60,00	0 lbs of TCE in the so	<u>il.</u>		
Attachmer	nts:						
		<u> </u>	<u> </u>			<u> </u>	

Hyd	rogeologic Conceptual	Model		Facility ID#: 0670
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments X Relatively homogeneous and permeable unconsolidated se Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone X Relatively homogeneous and permeable unconsolidated se Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments ower permeability material higher permeability material ediments sediments ower permeability material
<u>x</u>	Ground surface eleva	ation based on wells in c	or adjacent to treatment zone: 474 ft amsl	Unknown
<u>x</u>	Aquifer Characteristic Is more than 1 aquife Depth to water:	r present?	Aquifer 1 Aquifer 2 Aquifer 3 -12 (above grade)	nknown (assume single aquifer)
<u>x</u>	Flow direction	high value (ft bgs): Unknown:	<u>S to SE</u>	-
	_ Horizontal hydraulic g Vertical hydraulic gra			Unknown
x	K range (ft/day) Transmissivity (ft2/da	Measured low high y): Measured	1	Field data Unknown Field data
		low		Unknown

high

Comments:

Attachments:

Ther	rmal Treatment - Design								Facility ID#:	<u>0670</u>
<u>x</u>	Thermal treatment:		Conduc	tive						
		<u>x</u>	Electric	al Resistance						
			_	3 phase	_	6 phase		AC power	DC	power
			_ Steam	Steam	_	Steam + air	·	_ Steam + O2		
			Other (describe)						
<u>x</u>	Type of Test: <u>x</u>	Pilot	test	Fu	ill-scale Syst	em				
<u>x</u>	Geology of Treatment Zone):	<u>x</u>	Relative	ely homogei	neous and per	meable un	consolidated	sediments	
			_	Relative	ely homogei	neous and imp	ermeable i	unconsolidat	ted sediments	
			_	Largely	permeable	sediments wit	h inter-bed	ded lenses o	of lower perme	ability material
			_	Largely	impermeab	le sediments v	with inter-b	edded layers	s of higher perr	neability material
			_	Compet	ent, but fra	ctured bedrock	k (i.e. crysta	alline rock)		
			_	Weathe	red bedrocl	k, limestone, s	andstone			
<u>x</u>	Treatment Targe Zone:		Satura	ted only	Va	ndose only	<u>x</u>	Both (Satura	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	10/19	9/1998			Dura	tion: <u>42 d</u>			
	Hydraulic Control		Yes	No)					
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				· 			Unkn		x ft)
	Thickness of target zone (ft		,		<u>20.5</u>			Unkn		
	Depth to top of target zone			la (ft).	<u>3.5</u>			Unkn		
	Thickness of target zone be			ne (It):	<u>19</u>			Unkn		
	Number of energy delivery Number of extraction points).		<u>6</u> <u>1</u>			Unkn		
	Number of extraction points	٠.			<u> </u>				OWII	
<u>x</u>	Temperature Profile:									
_	Initial formation temperature	e (deg	g C):			<u>23</u>			Unknown	L
	Maximum representative fo	rmatio	on temp	erature (deg	C):	<u>95</u>			Unknown	ı
	Time to reach maximum rep	oresei	ntative t	emperature ((days):	<u>15</u>			Unknown	ı
	Duration of treatment at rep	reser	ntative te	emperature (days):	<u>27</u>			Unknown	ı
							<u>Date</u>		Temperatu	re (deg C)
	Formation temperature imm	nediat	ely post	-treatment:						
	Formation temperature pos	t-treat	tment m	onitoring eve	ent 1:	-				
	Duration of post-treatment i	nonito	oring (da	ays):						
<u>x</u>	Mass of contaminant remov				266	1		11.	1	II
			oumping			<u>i gal</u>		_ lb lb	kg	Unknown
	Tota		tream:		<u>30</u>	<u>890</u>	<u>X</u>	_lb	kg	Unknown
	Tota	١.		_				_ 10	kg	Chkhown
	Comments:									
	Total volu	ıme h	eated -	1800 yd3						
	Attachments:									

Cos	t and Performano	e				Facility ID#	: <u>0670</u>
<u>x</u>	Performance						
_	Remediation Go	oal:					
		<u>x</u>	In Groundwater:				
		=			98% removal of benze	ene	
		<u>x</u>	In Soil:		OO70 TOTHOVAL OF BOTIZE	<u>110</u>	
		^			98% removal of benzene		
					30 % Terrioval of berizerie		
	Was the Remed	diation	n Goal Achieved:				
			_ In Groundwater				
			Comment:				
			_ In Soil				
			Comment:				
	General comme	ents o	n the thermal appl	ication:			
	Goal to re	ach b	oiling point of water	er in subsurface and mai	ntain for 60 days		
	Lessons Learne	νd					
		;u					
							
	_ Energy						
	Total Energy Us	ed.			kWhr kWhr/r	m ³	k\Mhr/vd ³
	=-		al operay applied to	trootmont zono:			kWhr/yd ³
			al energy applied to er energy:			kWhr/m ³	kWhr/yd
		_ Othe		_		KVVNI/III	kwni/yd
			Pleas	se note other energy:			
	_ Cost						
	Total Project Co	ost:					
	-,		sultant Cost:				
			rmal Vendor Cost:				
			rgy Cost:		m ³ m	yd ³	
			•			yu	
			er Cost 1:				
			er Cost 2:				
	_	_	er Cost 3:				
	Please no	te oth	ner cost:	Other Cost 1:			
				Other Cost 2:			

____ Other Cost 3:

File Analyzed By: PD ____ Date: 10/30/2006 Type of treatment: ___ Conductive ___ Steam ____Other: Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: Jul-06 End of Test: Nov-06 Duration: 138 days Type of Site: Non-DOD _ DoD Facility Name: Bedford, OH Address: City, State, Zip Code: Bedford, OH OU# or Site #: Primary point of contact: **David Fleming** Organization: TRS Address: 7421-A Warren SE City, State, Zip Code: Snoqualmie, WA 98065 Phone #: 425-396-4266 email: dfleming@thermalrs.com Other contacts or vendors who worked on site _None Point of contact: Jeff Cossel Type: __ Vendor, Consultant ___ Vendor, Technical Applications __Other Organization: Visconsi Company Address: City, State, Zip Code: Pepper Pike, IL Phone #: <u>213-464-3580</u> email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0673

General Site Information

___ Hydraulic Conductivity information

General Site As	sessment Data					Facility II	D#: <u>0673</u>
Impacted	Impacted zone a	v direction)(ft.):			xness (ft):		Unknown
	Alternative meth		pacted zone (See source zo	ne definition attachmer	nts)		
Monitor V	Vells: Number of relevant m	nonitoring wells with ground			Deet to extend to		None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmer	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
Types of 0	Contaminants						
					ent Concentration per nical:	Average Post-treatm Cher	ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	x Benzene		None	1,000 mg/kg	None	10 mg/kg
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
	<u></u>						
Attachmer	nts:						

Hydrogeologic Conceptual Model

Zone

Vadose Zone:

Relatively homogeneous and permeable unconsolidated sediments

Relatively homogeneous and impermeable unconsolidated sediments

Relatively homogeneous and impermeable unconsolidated sediments

Largely permeable sediments with inter-bedded lenses of lower permeability material

Largely impermeable sediments with inter-bedded layers of higher permeability material

Competent, but fractured bedrock (i.e. crystalline rock)

Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _ Unknown Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): <u>18</u> high value (ft bgs): Unknown: _ Flow direction _ Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: _ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory _ Field data low Unknown high Comments:

Attachments:

The	rmal Treatment - Design									Facility ID#:	<u>0673</u>
<u>x</u>	Thermal treatment:		_ Conducti	ve							
		<u>x</u>	Electrical	l Resistance							
				3 phase	_	6 phase	-		AC power	DO	C power
			_ Steam	Steam		Steam + air	r		Steam + O2		
			Other (de				_				
<u>x</u>	Type of Test:	Pilot	_		-scale Syst	em					
<u>x</u>	Geology of Treatment Zone		· test	_		neous and pe	rmeahle	unco	nsolidated	l sediments	
^	Coology of Troutmont Zonk	.	<u>x</u>			•				ed sediments	
			Δ	•							ability material
										·	ability material
										s of fligher per	meability material
						ctured bedroc		-	ine rock)		
	.		<u> </u>			k, limestone, s					
<u>X</u>	Treatment Targe Zone:		_ Saturate	ea only	v	adose only				ated and Vadose	e zones)
<u>X</u>	Start of Thermal Test:	Jul-C				Dura	ation: 1	38 da	<u>ys</u>		
	_ Hydraulic Control		_ Yes	No							
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):				<u>5800</u>			_	Unkn	own (_ x ft)
	Thickness of target zone (f	t):			<u>25</u>			_	Unkn	own	
	Depth to top of target zone	(ft bg	ıs):		<u>7</u>			_	Unkn	own	
	Thickness of target zone be	elow v	water table	e (ft):	<u>16</u>			_	Unkn	own	
	Number of energy delivery	points	s:		<u>30</u>			_	Unkn	own	
	Number of extraction points	s:			<u>30</u>			-	Unkn	own	
<u>x</u>	Temperature Profile:										
	Initial formation temperatur	e (de	g C):			<u>15</u>				Unknow	n
	Maximum representative for			rature (deg C	C):	92				Unknow	n
	Time to reach maximum re		-			84				Unknow	n
	Duration of treatment at rep					<u>28</u>				Unknow	
			talı . m a at tı				<u>Date</u>			Temperatu	ure (deg C)
	Formation temperature imp				1.						
	Formation temperature pos Duration of post-treatment			_	н. т.	-					
	Duration of post-freatment	monii	oning (day	(5).							
	_ Mass of contaminant remo	ved:									
	Via I	liquid	pumping:				_	l	b	kg	Unknown
	In va	apor s	tream:	_			_	1	b	kg	Unknown
	Tota	al:			<u>33</u>	<u>890</u>	<u>x</u>	<u>(</u> 1	b	kg	Unknown
	Comments:										
	<u> </u>										
	Attachments:										
			_				•				

Cost	and Performance	е			Facility ID#:	<u>0673</u>
<u>x</u>	Performance					
_	Remediation Go	al:				
		x In Groundwater	:			
		_		Remove measurable from	ee product	
		x In Soil:				
		_	Reduc	e benzen to less than 5 mg/kg.	revised to 32 mg/kg	
	\\/ th D	istica Cool Ashissad				
	was the Remed	iation Goal Achieved:				
		x In Groundwater				
		Comment				
			No measurable free pr	oduct		
		x In Soil				
		Comment				
			17 of 21 samples belo	w 5 mg/kg and all below 32 mg/k	<u>ca</u>	
	General comme	nts on the thermal app	lication:			
	Lessons Learne	d 				
v	Enormy					
<u>x</u>	Energy Total Energy Us	a di		1-3371 1-101	h =/3 I/\A/	h = /, 3
	Total Energy Us			kWhr kW	nr/m kw kWhr/m³	
	<u>x</u>	Total energy applied	to treatment zone:	839281 kw-hrs		
		Other energy:			kWhr/m ³	kWhr/yd ³
		Plea	se note other energy:	-		
	Cost					
	Total Project Co	st.				
	•	Consultant Cost:				
		Thermal Vendor Cost				
		Energy Cost:	·	m ³	yd ³	
	·			m	yu	
		Other Cost 1:				
		Other Cost 2:				
		Other Cost 3:				
	Please not	te other cost:	Other Cost 1:			

Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	9/13/2006
	Type of treatment:	x Conductive		Steam		ERH	Other:		
	Type of Contaminant:	<u>x</u> Chlorinated Sol	vents		_ Petro	oleum Hydroc	arbons	Pesticides	
		Wood Treating			_Othe	r:			
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	Pilot Test	<u>x</u>	Full Scale	Systen	n			
	Start of Test:	5/19/2003		End o	of Test:	: varied		Duration: varie	<u>ed</u>
	Type of Site:	<u>x</u> Non-DOD		_DoD					
<u>x</u>	•	ial Midwest							
	Address:	261							_
	City, State, Zip Code: OU# or Site #:	Midwest							
									_
<u>x</u>	Primary point of contact:	Ralph S. Baker, Ph.D.	=						
	Organization: <u>TerraThern</u>	m, Inc.							
	Address: 10 Stevens Rd.								
	City, State, Zip Code:	Fitchburg, MA 01420	<u>)</u>						
	Phone #: 978-343-0300			email: <u>rbak</u>	er@tei	ratherm.com			
	Other contacts or vendors wh	no worked on site				None			
	Point of contact: Micl	hael L. Woodruff, CPG							
	Type: Vendor, C	onsultant	Vend	dor, Technic	al App	olications	<u>x</u> Oth	er <u>Oversight</u>	consultant
	Organization: The Payne	Firm, Inc.							
	Address: 11231 Cornell P	ark Dr.							
	City, State, Zip Code:	Cincinnati, OH 45242							
	Phone #: <u>513-489-2255</u>			email: mlw	@payr	nefirm.com			
Q	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	atment groundwater dat	a		<u>x</u>	Good pre- ar	nd post-treatmen	nt soil data	
	<u>x</u> Good temperature prof	file vs. time information				_Flux assessn	nent		
	Groundwater elevation	ns				_Geologic cro	ss-section		
	Hydraulic Conductivit	y information							

0685

General Site Information

<u>x</u> Impac	ted Zone:	x Impacted zone	w direction)(ft.): 240 as defined by documentation nod for determining size of im			eness (ft): 15		Unknown
		Map attachmen	t					
<u>x</u> Monite	or Wells:	Number of relevant i	monitoring wells with groundv		•	Doot trootmont		x None
		Number of wells rela	itive to treatment zone:	Pre-treatmer	nt:	Post-treatment:		
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ossgradient:	
		Post-treatment		Upgradient:	Downgradient:		ossgradient:	
x Soil Bo	orings:	Number of relevant se	oil borings with pre-treatment	data: 4	8			
		Number of relevant se	oil borings with post-treatmen	t data:	<u>14</u>			
		Number inside treatm	nent zone: 102	Number outs	ide treatment zone:			
<u>x</u> Types	of Contamina	ints		Г			T	
					Average Pre-treatme	ent Concentration per	Average Post-treatm	ent Concentration per
						nical:		nical:
_	С	hlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	_	chloroethene	Hexane	Creosote	None	100 mg/kg	None	0.05 mg/kg
	<u>x</u> Tet	rachloroethene	Jet Fuel		None	1 mg/kg	None	0.5 mg/kg
	1,1	-dichloroethene	Napthalene		None	None	None	None
	cis-	1,2-dichloroethene	Benzene		None	None	None	None
	tran	ns-1,2-dichloroethene	Tolune		None	None	None	None
	1,1	-dichloroethane	Ethylbenzene		None	None	None	None
	1,2	-dichloroethane	m/p-xylene		None	None	None	None
Chemicals		,1-trichloroethane	o-xylene		None	50 mg/kg	None	0.05 mg/kg
Concern		,2-trichloroethane			None	None	None	None
	1,1	,2,2-tetrachloroethane			None	None	None	None
	Vir	yl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
Com	ments:			This treatment area w	as known as Parking L	ot Area 1.		
	_							

0685

<u>x</u> Impacted	<u>x</u> Impacted zone a	s defined by documentation od for determining size of im	Width (ft): pacted zone (See source		eness (ft): 15		Unknown
<u>x</u> Monitor V	Vells: Number of relevant m	nonitoring wells with groundy	vater data: Pre-treatmen	ıt·	Post-treatment:		<u>x</u> None
	Number of wells relat	ive to treatment zone:	. To alouanon	<u> </u>			
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
x Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data: <u>1</u>	2			
		il borings with post-treatmen		8			
	Number inside treatme			de treatment zone:			
x Types of C	Contaminants						
					ent Concentration per nical:		nent Concentration per mical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	None	5 mg/kg	None	0.01 mg/kg
	x Tetrachloroethene	Jet Fuel		None	0.01 mg/kg	None	0.01 mg/kg
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Ohilf	x 1,1,1-trichloroethane	o-xylene		None	0.01 mg/kg	None	0.01 mg/kg
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme			This treatment area i	s known as Parking Lol	t <u>Area 2.</u>		
	-						

0685

x	Impacted	Zone:		as defined by documentation	Width (ft):		kness (ft): <u>15</u>		Unknown
			Alternative meth	nod for determining size of im t	pacted zone (See sourc	e zone definition attachme	nts)		
<u>x</u>	Monitor V	Vells:	Number of relevant r	monitoring wells with groundw	rater data:				x None
					Pre-treatme	ent:	Post-treatment:		
			Number of wells rela	tive to treatment zone:					
			Pre-treatment	In:	Upgradient:	_ Downgradient:	Cro	ssgradient:	
			Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
<u>x</u>	Soil Boring	js:	Number of relevant so	oil borings with pre-treatment	data:	<u>19</u>			
			Number of relevant so	oil borings with post-treatmen	t data:	<u>18</u>			
			Number inside treatm	ent zone: 37	Number out	side treatment zone:			
<u>x</u>	Types of C	Contaminan	ts						
							nent Concentration per mical:		ent Concentration per nical:
		Chi	lorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
			nloroethene	Hexane	Creosote	None	1 mg/kg	None	0.1 mg/kg
		x Tetra	nchloroethene	Jet Fuel		None	0.01 mg/kg	None	0.01 mg/kg
		1,1-0	lichloroethene	Napthalene		None	None	None	None
		cis-1	,2-dichloroethene	Benzene		None	None	None	None
		trans	-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-c	lichloroethane	Ethylbenzene		None	None	None	None
		1,2-0	lichloroethane	m/p-xylene		None	None	None	None
Chr	micals of	<u>x</u> 1,1,1	-trichloroethane	o-xylene		None	5 mg/kg	None	0.01 mg/kg
	oncern	1,1,2	-trichloroethane			None	None	None	None
		1,1,2	,2-tetrachloroethane			None	None	None	None
		Viny	l Chloride			None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
						None	None	None	None
	Comme	nts:							
				Thi	s treatment area is kn	own as the Former was	te water hasin		
				<u></u>	Jan aroa is kil	ao alo i olilloi was			
	Attachmer	nts:							
		_							

0685

Hyd	Irogeologic Conceptua	al Model		Facility ID#: 0685
×	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated set Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lot Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated set Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lot Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments ower permeability material in higher permeability material ediments sediments ower permeability material
<u>x</u>	Ground surface ele	vation based on wells in o	or adjacent to treatment zone: ft amsl	<u>x</u> Unknown
X	Aquifer Characteris Is more than 1 aqui Depth to water:		No Yes (number): U Aquifer 1 Aquifer 2 Aquifer 3 30* 35	inknown (assume single aquifer)
<u>x</u>	Flow direction		<u>sw</u>	-
<u>x</u>	Horizontal hydraulic	c gradient (feet/foot): radient (feet/foot):		<u>X</u> Unknown <u>X</u> Unknown
<u>x</u>	K range (ft/day)	Measured low high	using: Slug Test Laboratory 2.83(10 -5)	Field data Unknown
	Transmissivity (ft2/d	o o	using: Slug Test Laboratory	Field data X Unknown
	Comments:			

* Water was at 3 ft in a perched aquifer at Parking lot Area 1.

Attachments:

The	rmal Treatment - Design												Faci	lity ID#:	068	<u> 55</u>
<u>x</u>	Thermal treatment:	<u>x</u>	Conc	luctive	Parl	king L	ot Area	1								
			_ Elect	rical R	esistance											
					3 phase			6 phas	se		AC	ower		D	C powe	r
			_ Stear	n												
					Steam			Steam	+ air		Steam	m + O2	2			
			_ Othe	r (desc	ribe)											
<u>x</u>	Type of Test:	_ Pilot	test		<u>x</u> Full	l-scale	System									
<u>x</u>	Geology of Treatment Zone) :			Relativel	y hom	ogene	ous an	d permeal	ble und	conso	lidated	d sedi	iments		
				<u>x</u>	Relativel	y hom	ogene	ous an	d imperme	eable ι	ıncon	solida	ted se	ediments	5	
					Largely p	erme	able se	dimen	ts with inte	er-bed	ded le	enses	of low	ver perm	eability	material
					Largely in	mpern	neable	sedime	ents with i	inter-be	edded	l layer	s of h	nigher pe	rmeabil	ity material
					Compete	nt, bu	t fractu	red be	drock (i.e.	. crysta	alline	rock)				
					Weather	ed bed	drock, I	imesto	ne, sands	stone						
<u>x</u>	Treatment Targe Zone:		_ Satu	rated	only	<u>x</u>	Vado	se only	,	<u>x</u>	Both	(Satur	rated a	and Vados	se zones)
<u>x</u>	Start of Thermal Test:	5/19	/2003						Duration:	<u>195 c</u>	lays					
<u>x</u>	Hydraulic Control	<u>x</u>	Yes		No											
<u>x</u>	Treatment Cell Design:															
	Size of target zone (ft2):					141	87					_ Unkn	nown	(_	x	ft)
	Thickness of target zone (ft	t) :				<u>15</u>						Unkn	nown			
	Depth to top of target zone	(ft bg	js):			<u>0</u>						Unkn	nown			
	Thickness of target zone be	elow v	water t	table (f	ft):	<u>0</u>						Unkn	nown			
	Number of energy delivery points:				138						Unkn	nown				
	Number of extraction points	3:				<u>36</u>						Unkn	nown			
<u>x</u>	Temperature Profile:															
	Initial formation temperature	e (de	g C):					~13						Unknov	vn	
	Maximum representative fo	rmati	on ten	nperat	ure (deg 0	C):		at leas	st 100					Unknov	vn	
	Time to reach maximum re	prese	entative	e temp	erature (c	days):		<u>150</u>						Unknov	vn	
	Duration of treatment at rep	orese	ntative	temp	erature (d	ays):							<u>X</u>	Unknov	vn	
									Dat	<u>:e</u>			<u>I</u>	emperat	ure (de	g C)
	Formation temperature imn	nedia	tely po	st-trea	atment:											
	Formation temperature pos	t-trea	tment	monite	oring ever	nt 1:										
	Duration of post-treatment	monit	toring	(days)	:											
<u>x</u>	Mass of contaminant remov	ved:														
	Via I	iquid	pumpi	ing:							lb			_ kg	<u>x</u>	Unknown
	In va	apor s	tream	:	_						lb			_ kg	<u>x</u>	Unknown
	Tota	d:									_lb			_ kg	<u>x</u>	Unknown
	Comments:															
	Attachments:															
	Attaciments.															

The	rmal Treatment - Design					Facility ID#:	068	<u>5</u>
<u>x</u>	Thermal treatment:	<u>x</u> Conductive	Parking Lot	Area 2				
		Electrical Resis	tance					
		3 p	hase	6 phase	AC pow	rerI	OC power	•
		Steam						
			am	Steam + air	Steam +	O2		
		Other (describe)						
<u>x</u>	Type of Test:	Pilot test <u>x</u>	Full-scale S	•				
<u>x</u>	Geology of Treatment Zone	e: Re	latively homo	geneous and perme	able unconsolida	ated sediments		
		-	•	geneous and imperr				
				ole sediments with ir		•	-	
				eable sediments with			rmeabili	ty material
			•	fractured bedrock (i.	-	k)		
				ock, limestone, sand				
<u>X</u>	Treatment Targe Zone:	Saturated only	/ <u>x</u>	Vadose only		aturated and Vado	se zones)	
<u>X</u>	Start of Thermal Test:	5/19/2003		Duration	n: <u>205 days</u>			
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No					
<u>x</u>	Treatment Cell Design:							
	Size of target zone (ft2):		<u>3115</u>		U	nknown (_	x	ft)
	Thickness of target zone (f	t):	<u>15</u>		U	nknown		
	Depth to top of target zone	(ft bgs):	<u>0</u>		U	nknown		
	Thickness of target zone be	elow water table (ft):	<u>0</u>		U	nknown		
	Number of energy delivery	points:	<u>36</u>		U	nknown		
	Number of extraction points	s:	<u>5</u>		U	nknown		
<u>x</u>	Temperature Profile:							
	Initial formation temperatur	e (deg C):		<u>~13</u>		Unknow	wn	
	Maximum representative for	ormation temperature	(deg C):	atleast 100		Unknow	wn	
	Time to reach maximum re	presentative tempera	ture (days):	<u>70</u>		Unknow	wn	
	Duration of treatment at rep	oresentative temperat	ture (days):			<u>x</u> Unknow	vn	
				<u>Da</u>	<u>ate</u>	Tempera	ture (de	<u>a C)</u>
	Formation temperature imn	nediately post-treatme	ent:					
	Formation temperature pos		g event 1:	-		-		
	Duration of post-treatment	monitoring (days):						
<u>x</u>	Mass of contaminant remov	ved:						
	Via I	liquid pumping:			lb	kg	<u>x</u>	Unknown
	In va	apor stream:			lb	kg	<u>x</u>	Unknown
	Tota	d:			lb	kg	<u>X</u>	Unknown
	Comments:							
	Attachments:							

The	ermal Treatment - Design							Facility ID#:	068	<u>5</u>
<u>x</u>	Thermal treatment:	_	nductive ctrical Resistan		aste Water Basin					
		Stea	3 phas		6 phase		_AC power	D	C power	r
			Steamer (describe)	1	Steam + a	ir	_ Steam + O2	2		
<u>x</u>	Type of Test:	Pilot test		Full-scale	System					
×	Geology of Treatment Zone		Relat X Relat Large Large Comp	ively homo ively homo ely permea ely imperm petent, but	ogeneous and peopeneous and important in the sediments where the sediments of the sediments	ith inter-bed with inter-bed with inter-b	unconsolida ded lenses edded layer	ited sediments of lower perm	eability	
<u>x</u>	Treatment Targe Zone:	Sat	turated only	<u>x</u>	Vadose only		_ Both (Satur	rated and Vados	se zones)
<u>x</u>	Start of Thermal Test:	5/19/2003	<u>l</u>		Dur	ation: 190	days			
<u>x</u>	Hydraulic Control	<u>x</u> Yes		No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):			2409	<u>)</u>		Unkr	nown (_	x	ft)
	Thickness of target zone (f	t):		<u>15</u>			Unkr	nown		
	Depth to top of target zone	(ft bgs):		<u>0</u>			Unkr	nown		
	Thickness of target zone b	elow water	table (ft):	<u>0</u>			Unkr	nown		
	Number of energy delivery	points:		<u>32</u>			Unkr	nown		
	Number of extraction point	s:		<u>4</u>			Unkr	nown		
<u>x</u>	Temperature Profile:									
	Initial formation temperatur	e (deg C):			<u>~13</u>			Unknov	vn	
	Maximum representative for	ormation te	mperature (d	eg C):	atleast 100	<u>)</u>		Unknov	vn	
	Time to reach maximum re	presentativ	ve temperatui	re (days):	<u>135</u>			Unknov	vn	
	Duration of treatment at re	presentativ	e temperatur	e (days):				<u>X</u> Unknow	vn	
	Formation temperature imr	mediately p	oost-treatmen	t:		<u>Date</u>		Temperat	ure (de	g C)
	Formation temperature pos	st-treatmen	nt monitoring	event 1:						
	Duration of post-treatment	monitoring	(days):							
<u>x</u>	Mass of contaminant remo	ved:								
	Via	liquid pump	ping:				_ lb	kg	<u>x</u>	Unknown
	In va	apor strean	m:				_ lb	kg	<u>x</u>	Unknown
	Tota	al:				<u> </u>	_ lb	kg	<u>x</u>	Unknown
	Comments:									
	Attachments:									

Cost and Performance Facility ID#: 0685

Performance						
Remediation Goal:						
	In Groundwater: -					
	-					
<u>x</u>	In Soil:					
		TCE - 1.05	6 mg/kg; PCE - 5.	.94 mg/kg; 1,	1,1-TCA - 28.6 m	ig/kg
Was the Remediation	on Goal Achieved:					
	In Groundwater					
	Comment: -					
<u>s</u>	In Soil					
	Comment:					
	<u>ye</u>	<u>es</u>				
General comments	on the thermal applica	ation:				
—————	on the thermal applica					
Lessons Learned						
_						
Energy					. 3	
Total Energy Used:			<u>x</u> kWhr	kWhr		. kWhr/yd ³
	tal energy applied to to	reatment zone:			kWhr/m ³	kWhr/yd ³
Ot	her energy:	-		_	kWhr/m ³	kWhr/yd ³
	Please	note other energy:	-			
04						
Cost						
Total Project Cost:						
Co	onsultant Cost:					
Th	ermal Vendor Cost:	1,300,000	<u>0</u>			
En	ergy Cost:			m ³	yd ³	
Ot	her Cost 1:					
Ot	her Cost 2:					
Ot	her Cost 3:					
Please note o	ther cost:	Other Cost 1:				
		Other Cost 2:				
		Other Cost 3:				

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	10/30/2006
	Type of treatment:	Conductive	Steam	<u>x</u> ERH	Other:		
	Type of Contaminant:	Chlorinated Sol	lvents	Petroleum Hydroc	earbons	Pesticide	s
		Wood Treating	_	Other:			
	Treatment Status:	<u>x</u> Active	Post				
	Type of Test:	Pilot Test	Full Scal	le System			
	Start of Test:		Enc	l of Test:		_ Duration:	
	Type of Site:	Non-DOD	DoD				
<u>x</u>	Facility Name: Confident	ial, OK					
	Address:						
	City, State, Zip Code:	<u>OK</u>					
	OU# or Site #:						
<u>x</u>	Primary point of contact:	Bill Heath					
	Organization: <u>CES</u>						
	Address: 419 W. Entiat St	<u>t</u>					
	City, State, Zip Code:	Kennewick, WA 9933	<u>36</u>				
	Phone #: <u>509-727-4276</u>		email: <u>bill</u>	@cesiweb.com			
	_ Other contacts or vendors wl	ho worked on site		None			
	Point of contact:						
	Type:Vendor, C	Consultant	Vendor, Techn	ical Applications	Oth	ier	
	Organization:						
	Address:						
	City, State, Zip Code:						
	Phone #:		email:				
Q	A/QC						
	_ Characteristics of Interest						
	Good pre- and post-tre	atment groundwater da	ta	Good pre- a	nd post-treatme	nt soil data	
	Good temperature prof	file vs. time information	ı	Flux assessi	nent		
	Groundwater elevation	18		Geologic cr	oss-section		
	Hydraulic Conductivit	y information					

0690

General Site Information

General Site	Assessment Data					Facility II	D#: <u>0690</u>
Impact	ed Zone: Length (parallel to flow		Width (ft):	Thick	ness (ft):		Unknown
	 :	as defined by documentation					
		nod for determining size of im	npacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment	t					
Monito	or Wells: Number of relevant r	monitoring wells with ground					None
			Pre-treatment:		Post-treatment:		
		tive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Bo	rings: Number of relevant so	oil borings with pre-treatment	data:				
3011 1301		oil borings with post-treatmen					
	Number inside treatm			treatment zone:			
	Number made treatm		_ Number outside	treatment zone.			
Types	of Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Com	ments:	<u> </u>	<u> </u>	<u> </u>	·	·	
					······································		
				•		•	
Attachn	nents:						
	-						

Hydrogeolo	gic Conceptual Model			Facility ID#: 0690
Geolo	gy:	<u>Zone</u>	<u>Unconsolidated Sediments</u>	
	Vados	se Zone:	Relatively homogeneous and permeable unconsolidate	ed sediments
			Relatively homogeneous and impermeable unconsolid	ated sediments
			Largely permeable sediments with inter-bedded lenses	of lower permeability material
			Largely impermeable sediments with inter-bedded layer	ers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
	Satura	ated Zone:	Relatively homogeneous and permeable unconsolidate	ed sediments
			Relatively homogeneous and impermeable unconsolid	ated sediments
			Largely permeable sediments with inter-bedded lenses	s of lower permeability material
			Largely impermeable sediments with inter-bedded layer	ers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)	
			Weathered bedrock, limestone, sandstone	
Grour	nd surface elevation bas	sed on wells in o	adjacent to treatment zone: ft amsl	Unknown
Aquife	er Characteristics:			
Is mo	re than 1 aquifer preser	nt?	No Yes (number):	Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer	3
Depth	to water: low va	alue (ft bgs):		
	high v	alue (ft bgs):		
	Unkno	own:		
Flow o	direction			
Horizo	ontal hydraulic gradient	(feet/foot):		Unknown
Vertic	al hydraulic gradient (fe	eet/foot):		Unknown
K rang	ge (ft/day)	Measured	using: Slug Test Laboratory	Field data
		low		Unknown
		high		
Trans	missivity (ft2/day):	Measured	using: Slug Test Laboratory	Field data
		low		Unknown
		high		
Comn	nents:			
Attach	ments:			
	-			

The	ermal Treatment - Design							Facility ID#:	0690
<u>x</u>	Thermal treatment:		_ Conductive	e					
		<u>x</u>	Electrical I	Resistance					
				_ 3 phase	_	_ 6 phase	AC pow	er DO	C power
			_ Steam						
				_ Steam	-	Steam + air	Steam +	O2	
			Other (des	cribe)					
_	Type of Test:		t test	Full-	-scale Syste	m			
	_ Geology of Treatment Zon	ne:			_	eous and permea			
						•		idated sediments	
								es of lower perme	-
			_						meability material
						tured bedrock (i.e	-	k)	
			_	-		, limestone, sand			
	_ Treatment Targe Zone:		_ Saturated	only	Va			nturated and Vadose	
_	_ Start of Thermal Test:					Duration	:		
	Hydraulic Control		_ Yes	No					
	Treatment Cell Design:								
	Size of target zone (ft2):						U	nknown (_ x ft)
	Thickness of target zone	(ft):						nknown	,
	Depth to top of target zon		ıs):					nknown	
	Thickness of target zone			(ft):				nknown	
	Number of energy deliver			· /				nknown	
	Number of extraction poir						- <u></u>	nknown	
	•								
	_ Temperature Profile:								
	Initial formation temperatu	ıre (de	g C):					Unknow	n
	Maximum representative	formati	on tempera	ture (deg C	:):			Unknow	n
	Time to reach maximum r	eprese	entative tem	perature (d	ays):			Unknow	n
	Duration of treatment at re	eprese	ntative temp	perature (da	ays):			Unknow	n
						Da	<u>ite</u>	Temperatu	ıre (deg C)
	Formation temperature in	nmedia	tely post-tre	atment:					
	Formation temperature po	ost-trea	tment moni	toring even	t 1:	-			
	Duration of post-treatmen	t monit	toring (days):					
	_ Mass of contaminant rem								
		-	pumping:				lb	kg	Unknow
			stream:				lb	kg	Unknow
	То	tal:					lb	kg	Unknow
	Comments:								
	Attachments:								
			·			·			

st and Performance					Facility ID#:	<u>0690</u>
_ Performance						
Remediation Goal:	_					
	_ In Groundwater: -					
	<u>-</u>					
	_ In Soil:					
Was the Remediation						
	_ In Groundwater _					
	Comment: -					
	_					
	_ In Soil					
	Comment: -					
	_					
General comments of	n the thermal applica	ation:				
Lessons Learned						
_ Energy						
Total Energy Used:			kWhr	k\N/hr/m ³	k\/	Vhr/vd ³
	al energy applied to t	troatment zone:	KWIII		kWhr/m ³	wiii/yu kWhr/y
					_ kWhr/m ³	kWhr/y
Othe				_	_ KVVNI/M	KVVNr/y
	Please	note other energy:				
Cost						
Total Project Cost:						
-	sultant Cost:					
	rmal Vendor Cost:					
				_ m ³	3س،	
·	rgy Cost:				_ yd³	
	er Cost 1:					
	er Cost 2:					
	er Cost 3:					
Please note oth	er cost:	Other Cost 1:				
		Other Cost 2:				

_ Other Cost 3:

File Analyzed By: Date: JT PD <u>x</u> 9/13/2006 Type of treatment: Conductive Steam ERH ____Other: Type of Contaminant: _Chlorinated Solvents Petroleum Hydrocarbons Pesticides ___Wood Treating Other: Treatment Status: ___ Active Post Type of Test: Pilot Test Full Scale System Start of Test: 5/7/1998 End of Test: Sep-98 Duration: 120 days Type of Site: Non-DOD _DoD Facility Name: Former Shell Bulk Fuel Terminal Address: 245 Jackson St. City, State, Zip Code: Eugene, OR OU# or Site #: State of Oregon LUST #20-94-4004; ECSI#1566 Primary point of contact: Ralph Baker Organization: TerraTherm Address: 10 Stevens Road City, State, Zip Code: Fitchburg, MA 01420 Phone #: 978-343-0300 email: rbaker@terratherm.com Other contacts or vendors who worked on site _None Point of contact: Denis Conley Type: Vendor, Consultant ___ Vendor, Technical Applications _ Other Organization: Haley and Aldrich Address: 200 Town Centre Dr City, State, Zip Code: Rochester, NY 14623 Phone #: <u>585-321-4245</u> email: dconley@haleyaldrich.com QA/QC Characteristics of Interest Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data Good temperature profile vs. time information Flux assessment Groundwater elevations Geologic cross-section <u>X</u>

Facility ID#:

0700

General Site Information

Hydraulic Conductivity information

X

<u>x</u> Impacted Zone: Length (parallel to flow direction)(ft.): 125 Width (ft): Thickness (ft): Unknown 300 \underline{x} Impacted zone as defined by documentation _ Alternative method for determining size of impacted zone (See source zone definition attachments) ____ Map attachment Monitor Wells: Number of relevant monitoring wells with groundwater data: None Pre-treatment: 9 Post-treatment: Number of wells relative to treatment zone: Upgradient: 2 Pre-treatment In: <u>8</u> Downgradient: 3 Crossgradient: Upgradient: 2 Downgradient: 2 Post-treatment In: 4 Crossgradient: 1 x Soil Borings: Number of relevant soil borings with pre-treatment data: 18 Number of relevant soil borings with post-treatment data: 16 Number inside treatment zone: 16 Number outside treatment zone: Types of Contaminants Average Pre-treatment Concentration per Average Post-treatment Concentration per Chemical: Chemical: Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L) Soil (mg/kg) Chlorinated Solvents Petroleum Hydrocarbons Other Trichloroethene Hexane Creosote None None None None __ Tetrachloroethene __ Jet Fuel Diesel - TPH 10 mg/L 5,000 mg/kg 0.1 mg/L 1,000 mg/kg __1,1-dichloroethene __ Napthalene Gasoline - TPH 10 mg/L 1,000 mg/kg 0.1 mg/L None _ cis-1,2-dichloroethene 0.05 mg/kg Benzene 0.1 mg/L 0.5 mg/kg 0.001 mg/L _ trans-1,2-dichloroethene Tolune 0.1 mg/L 1 mg/kg 0.001 mg/L 0.05 mg/kg __1,1-dichloroethane 0.1 mg/L 0.001 mg/L 0.05 mg/kg Ethylbenzene 10 mg/kg __1,2-dichloroethane None None None m/p-xylene None ___1,1,1-trichloroethane o-xylene None None None None Chemicals of __1,1,2-trichloroethane 0.1 mg/L 10 mg/kg 0.001 mg/L 0.05 mg/kg xylenes (total) Concern _ 1,1,2,2-tetrachloroethane None None None None MTBE _ Vinyl Chloride None Comments: Attachments:

Facility ID#:

0700

Hydı	rogeologic Conceptual	Model		Facility ID#:	<u>0700</u>
<u>x</u>	Geology:	Zone	Unconsolidated Sediments		
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sed	iments	
			Relatively homogeneous and impermeable unconsolidated s	ediments	
			Largely permeable sediments with inter-bedded lenses of lov	ver permeability materia	al
			\underline{x} Largely impermeable sediments with inter-bedded layers of h	igher permeability mat	erial
			Competent, but fractured bedrock (i.e. crystalline rock)		
			Weathered bedrock, limestone, sandstone		
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sed	iments	
			Relatively homogeneous and impermeable unconsolidated s	ediments	
			Largely permeable sediments with inter-bedded lenses of lov	ver permeability materia	al
			x Largely impermeable sediments with inter-bedded layers of h	igher permeability mat	erial
			Competent, but fractured bedrock (i.e. crystalline rock)		
			Weathered bedrock, limestone, sandstone		
<u>x</u>	Ground surface eleva	ation based on wells in o	adjacent to treatment zone: 417 ft amsl	<u>x</u> Unknown	1
<u>x</u>	Aquifer Characteristic	cs:			
	Is more than 1 aquifer	r present?	No <u>x</u> Yes (number): <u>2</u> Unl	known (assume single aq	uifer)
			Aquifer 1 Aquifer 2 Aquifer 3		
	Depth to water:	low value (ft bgs):	<u>18</u>		
		high value (ft bgs):	<u>10</u> <u>19</u>		
		Unknown:			
	_ Flow direction				
	_ Flow direction				
<u>x</u>	Horizontal hydraulic g	gradient (feet/foot):		<u>x</u> Unknown	1
	Vertical hydraulic grad	dient (feet/foot):		<u>x</u> Unknown	1
<u>x</u>	K range (ft/day)	Measured	using: Slug Test <u>x</u> Laboratory	Field data	
		low	0.03 14	Unknown	1
		high	0.003 14		
	Transmissivity (ft2/day	y): Measured	using: Slug Test Laboratory	Field data	
		low		<u>x</u> Unknown	1
		high			
	Comments:				

Second water bearing unit - 5000 md

permeability: 1 to 10 millidarcy

Attachments:

The	rmal Treatment - Design			Fa	cility ID#: <u>0700</u>
<u>x</u>	Thermal treatment:	x Conductive			
		Electrical Resistance			
		3 phase	6 phase	AC power	DC power
		Steam			
		Steam	Steam + air	Steam + O2	
		Other (describe)			
<u>x</u>	Type of Test:	Pilot test <u>X</u> Full-	-scale System		
<u>x</u>	Geology of Treatment Zone	e: Relatively	homogeneous and perme	able unconsolidated se	diments
		Relatively	homogeneous and impern	neable unconsolidated	sediments
		Largely pe	ermeable sediments with in	ter-bedded lenses of lo	ower permeability material
		<u>x</u> Largely in	npermeable sediments with	inter-bedded layers of	f higher permeability material
			nt, but fractured bedrock (i.e.		
			ed bedrock, limestone, sand		
<u>X</u>	Treatment Targe Zone:	Saturated only			d and Vadose zones)
<u>X</u>	Start of Thermal Test:	5/7/1998	Duration	: <u>120 days</u>	
<u>x</u>	Hydraulic Control	<u>x</u> Yes No			
~	Treatment Cell Design:				
<u>x</u>	Size of target zone (ft2):		32000	Unknow	n (x ft)
	Thickness of target zone (fi	' †)•	<u>11.5</u>	Unknow	· — — · ·
	Depth to top of target zone		0	Unknown	
	Thickness of target zone be		0	Unknow	
	Number of energy delivery		<u>-</u> 761	Unknow	
	Number of extraction points		<u>277</u>	Unknow	
<u>x</u>	Temperature Profile:				
	Initial formation temperatur	e (deg C):		<u>x</u>	Unknown
	Maximum representative for	ormation temperature (deg C		<u>x</u>	Unknown
	Time to reach maximum re	epresentative temperature (da	ays):	<u>X</u>	Unknown
	Duration of treatment at rep	presentative temperature (da	ays):	<u>x</u>	Unknown
			D		Tanana matuma (da n O)
	Formation tomporature imp	modiately post treatment:	<u>Da</u>	<u>ate</u>	Temperature (deg C)
	Formation temperature pos	st-treatment monitoring even	+ 1·		
	Duration of post-treatment	_			
	Duration of poor troutmont	morning (dayo).			
<u>x</u>	Mass of contaminant remov	ved:			
	Via I	liquid pumping:		lb	kgUnknown
	In va	apor stream:		lb	kgUnknown
	Tota	al:	1.218 x 10^5	lb <u>x</u>	kg Unknown
	Comments:				
				0.45 /	
	dewatere	ed zone during treatment a		<u>,345 tons</u> acing on 7.5 ft center:	<u>s</u>
	Attachments:				

Performance Remediation Goal: In Groundwater: DEQ Tier 1 risk-based concentrations for all groundwater exposure paths In Soil: DEQ Tier 1 risk-based concentrations Was the Remediation Goal Achieved: In Groundwater Comment: <u>yes</u> In Soil X Comment: <u>yes</u> General comments on the thermal application: Lessons Learned Energy __ kWhr/yd³ ____ kWhr/m³ Total Energy Used: ____ kWhr __ Total energy applied to treatment zone: kWhr/m³ _ kWhr/yd³ _ kWhr/yd³ ___ Other energy: _ kWhr/m³ _ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ____ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: _ Please note other cost: Other Cost 1: _ Other Cost 2:

Other Cost 3:

Facility ID#:

0700

Cost and Performance

File Analyzed By: PD ____ Date: Type of treatment: Conductive ___ Steam ERH ____Other: <u>X</u> Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Pesticides Wood Treating Other: Treatment Status: _Active Post X Type of Test: Pilot Test Full Scale System Start of Test: 5/8/2000 End of Test: 11/14/2001 Duration: 17 months Type of Site: Non-DOD _ DoD Facility Name: ICN Pharmaceutical Address: City, State, Zip Code: Portland, OR OU# or Site #: _ Primary point of contact: Chuck Esler Organization: **AMEC** Address: City, State, Zip Code: Phone #: 503-639-3400 email: charles.esler@amec.com Other contacts or vendors who worked on site _ None Point of contact: Jennifer Sutter Type: _ Vendor, Consultant ___ Vendor, Technical Applications Other Regulator Organization: DEQ Northwest Region Address: 2020 SW 4th Ave., Suite 400 City, State, Zip Code: Portland, OR 97201 Phone #: 503-229-6148 email: sutter.jennifer@deq.state.or.us QA/QC Characteristics of Interest __Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data ___ Good temperature profile vs. time information Flux assessment __ Groundwater elevations Geologic cross-section

Facility ID#:

0720

General Site Information

___ Hydraulic Conductivity information

None	
Average Post-treatment Concentration per Chemical:	
er (mg/L) Soil (mg/kg)	
None	

0720

Hydrogeologic Conceptual Model Facility ID#: 0720

<u>x</u>	Geology:	<u>Z</u>	Zone_	Unconsolida	ted Sediment	<u>s</u>				
		Vados	e Zone:	x Relative	ely homogene	eous and per	rmeable unc	onsolidated s	sediments	
				Relative	ely homogene	eous and imp	permeable ui	nconsolidate	d sediments	
				Largely	permeable s	ediments wi	th inter-bedd	ed lenses of	lower permeab	ility material
				Largely	impermeable	e sediments	with inter-be	dded layers	of higher perme	ability material
				Compe	tent, but fract	ured bedroc	k (i.e. crystal	line rock)		
				Weathe	ered bedrock,	limestone, s	sandstone			
		Satura	ted Zone:	Relative	ely homogene	eous and per	rmeable unco	onsolidated s	sediments	
				Relative	ely homogene	eous and imp	permeable ui	nconsolidate	d sediments	
				<u>x</u> Largely	permeable s	ediments wi	th inter-bedd	ed lenses of	lower permeab	ility material
				Largely	impermeable	e sediments	with inter-be	dded layers	of higher perme	ability material
				Compe	tent, but fract	ured bedroc	k (i.e. crystal	line rock)		
				Weathe	ered bedrock,	limestone, s	sandstone			
<u>x</u>	Ground surface	e elevation base	ed on wells in	or adjacent to t	reatment zon	e:		ft amsl	<u>x</u>	Unknown
<u>x</u>	Aquifer Charac	teristics:								
	Is more than 1	nore than 1 aquifer present?			Yes (nu	mber):		<u>x</u>	Unknown (assum	e single aquifer)
				Aquifer 1		Aquifer 2	2	Aquifer 3		
	Depth to water:	: low val	lue (ft bgs):	<u>10</u>					<u> </u>	
		high va	alue (ft bgs):						_	
		Unkno	wn:							
<u>X</u>	Flow direction			<u>S</u>					_	
<u>x</u>	Horizontal hydr	raulic gradient ((feet/foot):						<u>X</u>	Unknown
	Vertical hydrau	ilic gradient (fee	et/foot):						<u>x</u>	Unknown
<u>X</u>	K range (ft/day)	Measured	_	Slug Tes	t	_ Laboratory		Field data	
			low	0.00283						_ Unknown
			high	<u>28.3</u>						
	Transmissivity	(π2/day):	Measured	using: _	Slug Tes		_ Laboratory		Field data	
			low	-					<u>X</u>	Unknown
			high						_	
	Commonto									
	Comments:	<u> 15-60' - 10e</u>	e-2 cm/s with	15-30' - being	fine silts;	at 60'+ - 5 ft				
		saturated z	ono				Low I	K is upper v	radose zone ai	nd high K is the
	Attachments:	Saturateu Zi	<u>one</u>							-
	Allacillicits.									

Ther	rmal Treatment - Design							Fac	ility ID#:	0720	!
<u>x</u>	Thermal treatment:		_ Conductive								
		<u>x</u>	Electrical R	Resistance							
				3 phase		6 phase	AC pov	ver	DC	power	
			_ Steam								
				Steam		Steam + air	Steam -	+ O2			
			Other (desc	ribe)							
<u>x</u>	Type of Test:	Pilot	test	<u>x</u> Full-	-scale System						
<u>x</u>	Geology of Treatment Zone	e:		Relatively	homogeneo	us and permeat	ble unconsolid	ated sec	liments		
			-	Relatively	homogeneo	us and imperme	eable unconso	lidated s	ediments		
			X	Largely pe	ermeable sed	diments with inte	er-bedded lens	ses of lov	wer permea	ability n	naterial
				Largely in	npermeable s	sediments with i	nter-bedded la	yers of I	nigher pern	neabilit	y material
			-	-		ed bedrock (i.e.	-	ck)			
				Weathere	d bedrock, lir	mestone, sands	tone				
<u>X</u>	Treatment Targe Zone:	<u>X</u>	Saturated	only	Vados	se only	Both (S	aturated :	and Vadose	zones)	
<u>X</u>	Start of Thermal Test:	5/8/2	2000			Duration:	17 months				
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No							
v	Treetment Cell Designs										
<u>x</u>	Treatment Cell Design: Size of target zone (ft2):				20000		т.	Inknown	(_	ft)
	Thickness of target zone (ft	٠١٠			20000		<u> </u>	Inknown	-	_ x	11)
	Depth to top of target zone		ie).		38 20		<u> </u>	Inknown			
	Thickness of target zone be			f+\-	_			Inknown			
	Number of energy delivery			11).	38 73			nknown			
	Number of extraction points	-	5.		73 53		<u> </u>	Inknown			
	Number of extraction points	·.			22			iikiiowii			
<u>x</u>	Temperature Profile:										
	Initial formation temperature	e (deg	g C):					<u>x</u>	Unknown		
	Maximum representative fo	rmatio	on temperat	ure (deg C	:):			<u>x</u>	Unknown		
	Time to reach maximum re	prese	ntative temp	perature (da	ays):			<u>x</u>	Unknown		
	Duration of treatment at rep	reser	ntative temp	erature (da	ays):			<u>x</u>	Unknown		
	Formation tomporature imp	a a di a t	taly past tra	otm ont:		Date	<u>e</u>	-	<u>Femperatu</u>	re (deg	<u>C)</u>
	Formation temperature imn				+ 1 .						
	Formation temperature pos Duration of post-treatment			•	ι ι.			-			
	Duration of post-freatment	monit	offing (days)								
<u>x</u>	Mass of contaminant remov	ved:									
	Via I	iquid	pumping:				lb		_ kg	<u>x</u>	Unknown
	In va	por s	tream:				lb		_ kg	<u>x</u>	Unknown
	Tota	l:					lb		_ kg	<u>x</u>	Unknown
	Comments:										
	<u>17.5 ft we</u> vd3	ell spa	acing and 1			well spacing fo		ne treat	ed of 29,6	500_	
	Attachments:										

and Performance					Facility ID#:	<u>0720</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	In Soil:					
	<u> </u>					
Was the Remediation						
_						
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k'	Whr/vd ³
	tal energy applied to t	reatment zone.			 _ kWhr/m³	kWhr/yc
	her energy:				_ kWhr/m ³	kWhr/yo
					_ KVVIII/III	KVVIII/yC
	Please	note other energy:				
Cost						
Total Project Cost:						
-	nsultant Cost:					
	ermal Vendor Cost:					
	ergy Cost:			m³	_ yd³	
					_ yu	
	her Cost 1:					
	her Cost 2:					
	her Cost 3:					
Please note of	ther cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

General Site Information Facility ID#: 0725 File Analyzed By: <u>x</u> PD ____ Date: 10/12/2006 ____Other: Type of treatment: ___ Conductive Steam ERH ___ Pesticides Type of Contaminant: _ Chlorinated Solvents Petroleum Hydrocarbons ____ Wood Treating Other: <u>X</u> coal tar Treatment Status: ____ Active Post Type of Test: Pilot Test Full Scale System Start of Test: 11/9/1994 End of Test: 6/7/1996 Duration: 567 d Type of Site: ____Non-DOD __ DoD Facility Name: <u>Brodhead Creek Superfund Site</u> Address: City, State, Zip Code: Stroudsburg, PA OU# or Site #: Primary point of contact: SITE doc: EPA/540/R-00/500 March 2000 Organization: Address: City, State, Zip Code: Phone #: email: ____ Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data

__ Flux assessment

____ Geologic cross-section

____ Good temperature profile vs. time information

___ Hydraulic Conductivity information

____ Groundwater elevations

Gen	eral Site Ass	sessment Data					Facility I	D#: <u>0725</u>			
<u>x</u>	Impacted 2	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	kness (ft):		<u>x</u> Unknown			
		Impacted zone a	as defined by documentation								
		Alternative method	od for determining size of im	pacted zone (See source zo	one definition attachmer	nts)					
		Map attachment									
	_ Monitor W	Vells: Number of relevant m	nonitoring wells with ground	vater data:				None			
				Pre-treatment:	<u> </u>	Post-treatment:					
		Number of wells relat	ive to treatment zone:								
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:				
		Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:				
<u>x</u>	Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data: <u>13</u>							
		Number of relevant so	il borings with post-treatmer	nt data: 13							
		Number inside treatme	Number inside treatment zone: 9-Sep Number outside treatment zone: 4-Apr								
X	Types of C	Contaminants									
Average Pre-treatment Concentration per Average Post-treatment Conce											
						ent Concentration per nical:		nent Concentration p mical:	er		
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
		Trichloroethene	Hexane	Creosote	None	None	None	None			
		Tetrachloroethene	Jet Fuel	x coal tar	None	None	None	None			
		1,1-dichloroethene	Napthalene	x TRPH	None	1,000 mg/kg	None	1,000 mg/kg			
		cis-1,2-dichloroethene	Benzene		None	None	None	None			
		trans-1,2-dichloroethene	Tolune		None	None	None	None			
		1,1-dichloroethane	Ethylbenzene		None	None	None	None			
		1,2-dichloroethane	m/p-xylene		None	None	None	None			
		1,1,1-trichloroethane	o-xylene		None	None	None	None			
	nemicals of Concern	1,1,2-trichloroethane			None	None	None	None			
		1,1,2,2-tetrachloroethane			None	None	None	None			
		Vinyl Chloride			None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
							1				
Comments:											
				TRPH mg/kg: p	ore = 1830 post= 16	<u>670</u>					
	Attachmen	its:							_		
		<u></u>							_		

0725

<u>x</u>	Geology:	<u>Zone</u>	Uncons	olidated Sedir	ments_					
		Vadose Zone:	Re	latively homo	geneous	and permea	able unconsolidated s	sediments		
			Re	latively homo	geneous	and imperm	eable unconsolidate	d sediments		
			<u>x</u> La	rgely permeal	ole sedim	ents with int	ter-bedded lenses of	lower permeabi	ility material	
			La	rgely imperme	eable sec	liments with	inter-bedded layers	of higher perme	ability material	
			Co	mpetent, but	fractured	bedrock (i.e	e. crystalline rock)			
			We	eathered bedr	ock, lime	stone, sand	stone			
		Saturated Zone:	Re	latively homo	geneous	and permea	able unconsolidated s	sediments		
			Re	latively homo	geneous	and imperm	eable unconsolidate	d sediments		
			<u>x</u> La	rgely permeat	ole sedim	ents with int	ter-bedded lenses of	lower permeabi	ility material	
			La	rgely imperme	eable sec	liments with	inter-bedded layers	of higher perme	ability material	
			Co	mpetent, but	fractured	bedrock (i.e	e. crystalline rock)			
			We	eathered bedr	ock, lime	stone, sand	stone			
<u>x</u>	Ground surface	elevation based on wells in o	r adjacen	t to treatment	zone:	<u>376</u>	ft amsl		Unknown	
<u>x</u>	Aquifer Charact	eristics:								
	Is more than 1 a	aquifer present?	No	Yes	s (number):	<u>x</u>	Unknown (assum	e single aquifer)	
			Aqu	ifer 1	A	quifer 2	Aquifer 3			
	Depth to water:	low value (ft bgs):	<u>3</u>					_		
		high value (ft bgs):	<u>15</u>					_		
		Unknown:						_		
<u>x</u>	Flow direction		<u>E</u>					_		
<u>X</u>	Horizontal hydra	aulic gradient (feet/foot):	0.005						Unknown	
	Vertical hydraul	ic gradient (feet/foot):						<u>x</u>	Unknown	
<u>X</u>	K range (ft/day)	Measured	using:	Slug	Test	La	boratory	Field data		
		low	<u>200</u>						_ Unknown	
		high						_		
	Transmissivity (using:	Slug	Test	La	boratory	Field data		
		low						<u>X</u>	Unknown	
		high						_		
	Comments:	porosity n=0.3								
										_
		= 100 to 150 Darcies								_
	Attachments:									_
										_

The	rmal Treatment - Design					Facility ID#:	<u>0725</u>
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Res	sistance				
		3	phase	_ 6 phase	AC power	DC	power
		x Steam C	CROW				
		S	team	Steam + air	Steam + O2	2	
		Other (describ	pe)				
<u>x</u>	Type of Test:	Pilot test x	Full-scale Syste	m			
<u>x</u>	Geology of Treatment Zone	e: F	Relatively homogen	eous and permea	ble unconsolidated	d sediments	
		F	Relatively homogen	eous and imperm	eable unconsolida	ted sediments	
		<u>x</u> L	argely permeable	sediments with int	er-bedded lenses	of lower perme	ability material
		L	argely impermeabl	e sediments with	inter-bedded layer	s of higher perr	neability material
			Competent, but frac	tured bedrock (i.e	e. crystalline rock)		
		V	Veathered bedrock	, limestone, sands	stone		
<u>x</u>	Treatment Targe Zone:	x Saturated or	nly Va	dose only	Both (Satur	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	11/9/1994		Duration:	567 d		
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No				
<u>x</u>	Treatment Cell Design:						
	Size of target zone (ft2):		<u>3200</u>		Unkn	own (40 x <u>80</u> ft)
	Thickness of target zone (fi	t):			<u>x</u> Unkn	iown	
	Depth to top of target zone	(ft bgs):			<u>x</u> Unkn	iown	
	Thickness of target zone be				<u>x</u> Unkn		
	Number of energy delivery		<u>6</u>		Unkn		
	Number of extraction points	s:	<u>2</u>		Unkn	iown	
~	Temperature Profile:						
<u>x</u>	Initial formation temperatur	re (dea C):		<u>20</u>		Unknowr	1
	Maximum representative for		e (dea C):	20 70		Unknown	
	Time to reach maximum re	•		<u>461</u>		Unknowr	
	Duration of treatment at rep			<u>1</u>		Unknowr	
	·		, ,	_			
				<u>Dat</u>	<u>te</u>	Temperatu	re (deg C)
	Formation temperature imm	nediately post-treat	ment:				
	Formation temperature pos	st-treatment monitor	ing event 1:				
	Duration of post-treatment	monitoring (days):					
<u>x</u>	Mass of contaminant remove						
		liquid pumping:			lb	kg	<u>x</u> Unknown
		apor stream:	1504		lb	kg	<u>X</u> Unknown
	Tota	AI:	<u>1504</u>	gal	lb	kg	Unknown
	Comments:						
	Attachments:						

Cost and Performance	ce		Facility ID#: 0725
Performance			
Remediation G	oal:		
	In Groundwater: -		
	In Soil:		
	111 3011.		
Was the Remed	diation Goal Achieved:		
	In Groundwater		
	Comment:		
	_		
	In Soil		
	Comment: -		
	_		
General comme	ents on the thermal applic	ation:	
Pore volu	mes flushed = 25.5 (at \$8	5000/pore volume)	
			the Pore volume size is 455,000 gallons
Lessons Learne	ed.		
-			
Enorgy			
Energy	d.		kWhr kWhr/m³ kWhr/yd³
Total Energy U	· · · · · · · · · · · · · · · · · · ·		
	_ Total energy applied to	treatment zone:	kWhr/m³kWhr/yd³
	_ Other energy:		kWhr/m ³ kWhr/yd ³
	Please	note other energy:	
0			
x Cost			
Total Project Co		<u>2168000</u>	
	_ Consultant Cost:		
	_ Thermal Vendor Cost:		<u></u>
<u>x</u>	Energy Cost:	60000	$\underline{\hspace{1cm}}$ m ³ $\underline{\hspace{1cm}}$ yd ³
	_ Other Cost 1:		
_	_ Other Cost 2:		
	Other Cost 3:		
Diago no	te other cost:	Other Cost 1:	
Please no	te offier cost:		
	=	Other Cost 2:	
	_	Other Cost 3:	

PD ____ File Analyzed By: Date: 10/26/2006 ____Other: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: _____ Type of Site: DoD _Non-DOD <u>X</u> Facility Name: Naval Construction Battallion Center (Former NIKE) City, State, Zip Code: North Kingston, RI OU# or Site #: Primary point of contact: Christine willaims Organization: Address: City, State, Zip Code: Phone #: 617-918-1384 email: ____ Other contacts or vendors who worked on site _ None Point of contact: Ian Osgerby Type: __ Vendor, Consultant _____ Vendor, Technical Applications Other Organization: Navy Address: City, State, Zip Code: Phone #: 978-318-8631 email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0730

General Site Information

___ Hydraulic Conductivity information

General Site As	ssessment Data					Facility II	D#: <u>0730</u>
Impacted	5 "	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
		nod for determining size of im		one definition attachmen	its)		
	Map attachment	=	,				
Monitor \	Wells: Number of relevant n	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	tive to treatment zone:	r ro abdanona				
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
				3			
Soil Borin	gs: Number of relevant so	oil borings with pre-treatment	data:				
		oil borings with post-treatmer					
	Number inside treatme			e treatment zone:			
Types of 0	Contaminants						
				Average Pre-treatme Chen	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
-	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
Concern	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
Attachme	nts:						

Hydrogeologic Cor	nceptual Model			Facility ID#:	0730
Geology:	Zor	<u>ne</u>	Unconsolidated Sediments		
	Vadose 2	Zone:	Relatively homogeneous and permeable und	consolidated sediments	
			Relatively homogeneous and impermeable u	inconsolidated sediments	
			Largely permeable sediments with inter-bed	ded lenses of lower permeability materia	ıl
			Largely impermeable sediments with inter-be	edded layers of higher permeability mate	erial
			Competent, but fractured bedrock (i.e. crysta	ılline rock)	
			Weathered bedrock, limestone, sandstone		
	Saturated	d Zone:	Relatively homogeneous and permeable und	consolidated sediments	
			Relatively homogeneous and impermeable u	inconsolidated sediments	
			Largely permeable sediments with inter-bed	ded lenses of lower permeability materia	d
			Largely impermeable sediments with inter-be	edded layers of higher permeability mate	erial
			Competent, but fractured bedrock (i.e. crysta	ılline rock)	
			Weathered bedrock, limestone, sandstone		
Ground surfa	ice elevation based	on wells in o	or adjacent to treatment zone:	ft amsl Unknown	
Aquifer Chara	acteristics:				
Is more than	1 aquifer present?		No Yes (number):	Unknown (assume single aqu	ifer)
			Aquifer 1 Aquifer 2	Aquifer 3	
Depth to water	er: low value	e (ft bgs):			
	high valu	e (ft bgs):			
	Unknowr				
Flow direction	n				
Horizontal hv	draulic gradient (fe	et/foot):		Unknown	
•	aulic gradient (feet/			Unknown	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3 (,			
K range (ft/da	av)	Measured	using: Slug Test Laboratory	Field data	
	,,	low	2.0g .55t 2.050.005,	I lold data Unknown	
		high			
Transmissivit	tv (ft2/dav):	Measured	using: Slug Test Laboratory	Field data	
. ranomioorn	., (,).	low		I lota data Unknown	
		high		Olikliowii	
		iligii			
Comments:					
Comments.					
Attachmanta			-		
Attachments:					

Thermal Treatment - Design			Facility ID:	#: <u>0730</u>
x Thermal treatment:	Conductive			
	Electrical Resistance			
	3 phase x Steam	6 phase	AC power	DC power
	SteamSteamOther (describe)	Steam + air	Steam + O2	
 X Type of Test: X Geology of Treatment Zon 	Pilot test Full-scale S		unconsolidated sediments	
	Largely permea Largely imperm Competent, but	ble sediments with inter-b		meability material
Treatment Targe Zone: Start of Thermal Test:	Saturated only	-	Both (Saturated and Vac	
Hydraulic Control	Yes No	_		
Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (ft2): Depth to top of target zone (ft2): Thickness of target zone (ft2): Number of energy delivery Number of extraction point Temperature Profile: Initial formation temperature	e (ft bgs): pelow water table (ft): points: ts:		Unknown (UnknownUnknownUnknownUnknownUnknown	x ft)
Maximum representative f	ormation temperature (deg C):		Unkr	own
	epresentative temperature (days): epresentative temperature (days):		Unkr Unkr	
Formation temperature im	mediately post-treatment: st-treatment monitoring event 1:	<u>Date</u>		rature (deg C)
Duration of post-freatment	monitoring (days).			
Mass of contaminant remo				
	liquid pumping:	-	lb kg	Unknown
In v	apor stream:al:		lb kg lb kg	Unknown Unknown
Comments:				
Attachments:				

and Performance					Facility ID#:	<u>0730</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_	·					
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k'	Whr/yd ³
To	tal energy applied to t	reatment zone:	· 		_ kWhr/m ³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:				
	110000	note enter energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
Th	ermal Vendor Cost:					
En	ergy Cost:			m³	_ yd³	
	her Cost 1:					
	her Cost 2:					
	her Cost 3:					
Oil		Other Cost 1:				
riease note of		Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD			Date:	11/6/2006
	Type of treatment:	Conductive	Steam	<u>X</u> ERH	Other:	
	Type of Contaminant:	X Chlorinated Solvent	ts	Petroleum Hydrocarbo	nsPesti	cides
		Wood Treating		Other:		
	Treatment Status:	Active <u>X</u>	<u>K</u> Post			
	Type of Test:	X Pilot Test _	Full Scale	System		
	Start of Test:	11/7/1993	End	of Test: 12/2/1993	Duration	: <u>25 d</u>
	Type of Site:	x Non-DOD _	DoD			
<u>X</u>	•	River Site				
	Address:					
	City, State, Zip Code:	Aiken, SC				
	OU# or Site #: <u>Site 321 -</u>	Area M				
<u>X</u>	Primary point of contact:	Mark Amidon				
	Organization: <u>Savannah</u>	River Site				
	Address:					
	City, State, Zip Code:					
	Phone #: 803-952-7781		email: mar	k.amidon@srs.gov		
<u>X</u>	Other contacts or vendors w	ho worked on site		None		
		Kupar and Brian Looney				
	Type:Vendor, C			cal Applications	Other	
	Organization: <u>Savannah</u>	River Site /	Savannah	River National Laborator	<u>y_</u>	
	Address:					
	City, State, Zip Code:					
	Phone #: 803-952-6525	/ 803-725-3692	email: jam	es.kupar@srs.gov / bi	ian02.looney@srnl.doe.	gov
Q.	A/QC					
	_ Characteristics of Interest	t				
	Good pre- and post-tre	eatment groundwater data		Good pre- and po	ost-treatment soil data	
	Good temperature pro-	file vs. time information		Flux assessment		
	Groundwater elevation	ns		Geologic cross-se	ection	
	Hydraulic Conductivit	ty information				

<u>0740</u>

General Site Information

Gene	eral Site As	sessment Data					Facility I	D#: <u>0740</u>				
<u>x</u>	Impacted :	Zone: Length (parallel to flow	/ direction)(ft.): >25000	Width (ft):	>16400 Thi	ckness (ft):		Unknown				
		Impacted zone a	s defined by documentation									
		X Alternative method	od for determining size of im	pacted zone (See source zo	one definition attachm	ents)						
		Map attachment										
<u>X</u>	Monitor V	Vells: Number of relevant m	nonitoring wells with ground					None				
				Pre-treatment:	0	Post-treatment:						
		Number of wells relati				_						
		Pre-treatment	In:	Upgradient:	Downgradien	· ·	ssgradient:					
		Post-treatment	In:	Upgradient:	Downgradien	t: Cro	ssgradient:					
٧.	0-11 D1	North and fortunation	71 h	data.								
<u>X</u>	Soil Boring		il borings with pre-treatment									
			il borings with post-treatmer		trootmont zono.	7						
	Number inside treatment zone: 5 Number outside treatment zone: 7											
<u>x</u>	Types of Contaminants											
Δ												
	Average Pre-treatment Concentration per Chemical: Average Post-treatment Concentration per Chemical: Chemical:											
	Chlorinated Solvents Petroleum Hydrocarbons Other Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L) Soil (mg/kg)											
		X Trichloroethene	Hexane	Creosote	None	0.01 mg/kg	None	None				
		X Tetrachloroethene	Jet Fuel		None	0.05 mg/kg	None	None				
		1,1-dichloroethene	Napthalene		None	None	None	None				
		cis-1,2-dichloroethene	Benzene		None	None	None	None				
		trans-1,2-dichloroethene	Tolune		None	None	None	None				
		1,1-dichloroethane	Ethylbenzene		None	None	None	None				
		1,2-dichloroethane	m/p-xylene		None	None	None	None				
Che	emicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None				
	Concern	1,1,2-trichloroethane			None	None	None	None				
		1,1,2,2-tetrachloroethane			None	None	None	None				
		Vinyl Chloride			None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
					None	None	None	None				
	Comme	nte:										
	Commi	1110.										
		ave	erage post treatment soils	concentrations for both co	onstituents at 0.000	11 ma/Ka. From ele	vations 328 to 318.					
												
	Attachmen	nts:										

Hyd	rogeologic Conceptual	Model								Facility II	D#:	<u>0740</u>
<u>X</u>	Geology:	<u>Zone</u>	Uncons	solidated S	Sedime	ents_						
		Vadose Zone:	R	elatively he	omoge	eneous ar	nd permeal	ble uncons	olidated se	diments		
			R	elatively h	omoge	eneous ar	nd imperme	eable unco	nsolidated	sediments		
			X La	argely perr	meable	e sedimer	nts with inte	er-bedded	lenses of lo	wer permeat	ility material	
			La	argely impo	ermea	ble sedim	nents with i	inter-bedde	ed layers of	higher perme	eability mate	ial
			C	ompetent,	but fra	actured be	edrock (i.e.	. crystalline	e rock)			
			W	eathered l	bedro	ck, limesto	one, sands	stone				
		Saturated Zone:	R	elatively h	omoge	eneous ar	nd permeal	ble uncons	olidated se	diments		
				•	•		•		nsolidated			
			_							wer permeat	•	
									-	higher perme	eability mate	ial
							edrock (i.e.	•	e rock)			
			w	eathered I	bedroo	ck, limesto	one, sands	stone				
<u>X</u>	Ground surface eleva	ation based on wells in o	r adjacer	nt to treatn	nent zo	one:	<u>355</u>	ft	amsl		Unknown	
<u>X</u>	Aquifer Characteristic	os:										
	Is more than 1 aquife	r present?	No	<u>X</u>	Yes (number):	<u>2</u>		U	nknown (assur	ne single aqui	fer)
			Aqu	uifer 1		Aqu	uifer 2	A	quifer 3			
	Depth to water:	low value (ft bgs):	<u>135</u>		1	60				-		
		high value (ft bgs):								_		
		Unknown:						-		6		
<u>X</u>	Flow direction		<u>NE</u>		-					_		
	_ Horizontal hydraulic (_	Unknown	
	Vertical hydraulic gra	idient (feet/foot):								_	Unknown	
	_ K range (ft/day)	Measured	usina.	;	Slua T	est	Lab	oratory		Field data		
	_ rerainge (inday)	low	doing.		olug i	001		oratory	_	r icia aaa	Unknown	
		high										
	Transmissivity (ft2/da	•	using:	;	Slug T	est	Lab	oratory		Field data		
	,,	low									Unknown	
		high										

Downward gradient of 2 to 8 ft/yr. Radial flow outward at 15 to 100 ft/yr.

Comments:

Attachments:

The	ermal Treatment - Do	esign								Facil	lity ID#:	<u>0740</u>	
X	Thermal treatmen	nt:		_ Conduc	ctive								
			<u>X</u>	Electric	cal Resistance								
				_	3 phase		X 6 phase	<u>X</u>	AC pov	ver	DC p	ower	
				_ Steam									
				_	Steam	,	Steam + a	ir _	Steam	+ O2			
				Other (describe)								
<u>X</u>	Type of Test:	<u>X</u>	Pilo	t test	Ful	l-scale Sy	stem						
<u>X</u>	Geology of Treatr	ment Zor	ne:	_	Relative	y homog	eneous and pe	ermeable	unconsolid	ated sedi	ments		
				_	Relativel	y homog	eneous and im	npermeabl	e unconso	lidated se	ediments		
				_	Largely	permeab	le sediments w	ith inter-b	edded lens	ses of low	er permeab	ility ma	terial
				<u>×</u>	Largely i	mperme	able sediments	with inter	-bedded la	ayers of h	igher perme	ability r	materia
				_	Compete	ent, but fi	actured bedro	ck (i.e. cry	stalline ro	ck)			
				_	Weather	ed bedro	ck, limestone,	sandston	е				
<u>X</u>	Treatment Targe	Zone:		_ Satura	ted only	<u>X</u>	Vadose only	_	Both (S	Saturated a	nd Vadose zo	ones)	
<u>X</u>	Start of Thermal 7	Гest:	11/7	//1993			Dur	ration: 25	<u>i d</u>				
<u>X</u>	Hydraulic Control		<u>X</u>	Yes	No								
<u>X</u>	Treatment Cell De	esign:											
	Size of target zon	e (ft2):				710			t	Jnknown	(<u>30</u>	x	<u>30</u> ft)
	Thickness of targe	et zone ((ft):			<u>21</u>			t	Jnknown			
	Depth to top of ta	rget zone	e (ft b	gs):		23			t	Jnknown			
	Thickness of targe	et zone b	pelow	water tab	ole (ft):	<u>0</u>			t	Jnknown			
	Number of energy	delivery	y point	s:		<u>6</u>			t	Jnknown			
	Number of extrac	tion poin	ts:			<u>4</u>			t	Jnknown			
	_ Temperature Prof	file:											
	Initial formation te	emperatu	ıre (de	g C):			<u>20</u>				Unknown		
	Maximum represe	entative f	format	ion temp	erature (deg	C):	<u>100</u>				Unknown		
	Time to reach ma	ximum r	eprese	entative t	emperature (days):	<u>8</u>				Unknown		
	Duration of treatm	nent at re	eprese	ntative te	emperature (d	lays):	<u>17</u>				Unknown		
								Date		<u>T</u>	emperature	(deg C	<u>)</u>
	Formation temper	rature im	media	tely post	-treatment:		12/3/1993			<u>100</u>			
	Formation temper	rature po	st-trea	atment m	onitoring eve	nt 1:							_
	Duration of post-t	reatment	t moni	toring (da	ays):								
	_ Mass of contamin	ant remo	oved:										
		Via	liquid	pumping	g: <u> </u>			_	lb		kg		Unknov
		In v	apor :	stream:	_				lb		kg		Unknov
		Tot	al:		_				lb		kg		Unknov
	Comments:												
	-	1430 yd	3 of h	eated so	<u>lic</u>								
	Attachments:												
	-												

Cos	st and Performance					Facility ID#:	0740
<u>x</u>	Performance						
_	Remediation Goal	:					
		In Groundwater:					
	_						
	<u>x</u>	In Soil: <u>Test</u>	to evaluate the enhance		inated VOCs from eating.	subsurface sec	diments using ohmic
	Was the Remedia	tion Goal Achieved:					
	was the remedia	In Groundwater					
	_	Comment:					
		Commont					
		In Soil					
	_	Comment:					
		Comment.					
		,					
	General comments	s on the thermal appli	cation:				
	Lessons Learned						
	Lessons Learned						
	Extraction w	all should be screened	d above and below clay	lonco			
	EXITACTION W	ell stiould be screened	d above and below clay	lense.			
<u>x</u>	Energy						
	Total Energy Used	i: <u>100,0</u>	00	<u>x</u> kWhr	kWhr/m ³	k\	Whr/yd ³
	<u>x</u> T	otal energy applied to	treatment zone:	<u>70</u>		_ kWhr/m³	<u>x</u> kWhr/yd ³
		Other energy:	_	 -		_ kWhr/m³	kWhr/yd ³
		Pleas	e note other energy:			_	
			0,				-
<u>x</u>	Cost						
	Total Project Cost:	:	1,277,300				
	c	Consultant Cost:					
	Т	onsultant oost.					
		hermal Vendor Cost:					
	E				m³	_ yd³	
		hermal Vendor Cost:			m³	_ yd³	
	c	Thermal Vendor Cost:			m³	_ yd³	
	c	Thermal Vendor Cost: Energy Cost: Other Cost 1:			m³	_ yd³	
	c	thermal Vendor Cost: inergy Cost: Other Cost 1: Other Cost 2: Other Cost 3:	Other Cost 1:		m³	_ yd³	

____ Other Cost 3:

<u>X</u> PD ____ File Analyzed By: Date: 9/25/2007 ____Steam ____Other: Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating _Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: 6/15/2006 End of Test: Duration: _____ Type of Site: Non-DOD __ DoD Facility Name: Savannah River Site - C Reactor Area Address: City, State, Zip Code: Aiken, SC OU# or Site #: C Reactor Primary point of contact: Joseph Amari Organization: Washington Savannah River Company Address: City, State, Zip Code: Phone #: email: ___ Other contacts or vendors who worked on site _ None Point of contact: Robert F. Blundy ____ Vendor, Technical Applications Type: ___ Vendor, Consultant ____ Other Organization: <u>Washington Savannah River Company</u> Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0742

General Site Information

____ Hydraulic Conductivity information

Gene	eral Site As	sessment Data					Facility II	D#: <u>0742</u>
_	Impacted :	Zone: Length (parallel to flow	direction)(ft.):	Width (ft):	Thick	ness (ft):	_	Unknown
		X Impacted zone as	s defined by documentation					
		Alternative method	od for determining size of im	pacted zone (See source zo	ne definition attachmen	ts)		
		Map attachment						
	Monitor V	Vells: Number of relevant m	onitoring wells with ground	water data:				None
				Pre-treatment:		Post-treatment:		
		Number of wells relati	ve to treatment zone:					
		Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	0-11 D1	Number of selection	11 h	. data.				
_	Soil Boring		il borings with pre-treatment il borings with post-treatmer					
		Number inside treatme			trootmont zono:			
		Number inside treatme	ent zone.	_ Number outside	treatment zone:			
<u>x</u>	Types of C	Contaminants						
Δ	Types of C	outaminants						
						nt Concentration per		ent Concentration per
		Chloriosted Colorest	Datas lassas Hardan and assa	Other	Chen Groundwater (mg/L)	Soil (mg/kg)	Chen Groundwater (mg/L)	Soil (mg/kg)
		Chlorinated Solvents X Trichloroethene	Petroleum Hydrocarbons Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel	Creosote				
					None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
			m/p-xylene		None	None	None	None
	emicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
<u> </u>					None	None	None	None
	Comme	nts:						
		-						
								-
				-				
	Attachmen	nts:						
							·	

Hyd	rogeologic Conceptual	l Model							ı	Facility ID	#:	0742
<u>X</u>	Geology:	Zone	Uncons	solidated s	Sedir	ments_						
		Vadose Zone:	R	elatively h	omo	geneous ar	nd permeat	ole unconsolida	ted sedime	ents		
			R	elatively h	omo	geneous ar	nd imperme	eable unconsoli	dated sedi	ments		
			<u>X</u> La	argely per	meal	ole sedimer	nts with inte	er-bedded lense	s of lower	permeabi	lity material	
			La	argely imp	erme	eable sedim	ents with i	nter-bedded lay	ers of high	ner perme	ability mater	ial
			C	ompetent,	but	fractured be	edrock (i.e.	crystalline rock	:)			
			Weathered bedrock, limestone, sandstone									
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments									
			Relatively homogeneous and impermeable unconsolidated sediments									
			X La	argely per	meal	ole sedimer	nts with inte	er-bedded lense	s of lower	permeabi	lity material	
			Largely impermeable sediments with inter-bedded layers of higher permeability material								ial	
			C	ompetent,	but	fractured be	edrock (i.e.	crystalline rock	:)			
			Weathered bedrock, limestone, sandstone									
	_ Aquifer Characteristi Is more than 1 aquife Depth to water:		No Aqu	<u>X</u> uifer 1	Yes	s (number): Aqu	3 uifer 2	Aquife		wn (assum	e single aquit	er)
	_ Flow direction				_		a					
	_ Horizontal hydraulic	gradient (feet/foot):			_		a				Unknown	
	Vertical hydraulic gra	adient (feet/foot):			_						Unknown	
	_ K range (ft/day)	Measured o	using:		Slug	Test	Lab	oratory	1	Field data	Unknown	
		high			_						_ CHKHOWII	
	Transmissivity (ft2/da	_	isina.		Sluc	Test	Lab	oratory		Field data		
	Transmissivity (ItZ/ue	low	Joniy.		Jiug	1001	Lao	O14tO1y		i iciu uata	Unknown	
		high			_			-			_ CHKHOWII	
		iligii			_							

Comments:

Attachments:

Average K=0.4 ft/min

The	rmal Treatment - Design							F	acility ID#:	<u>0742</u>
<u>X</u>	Thermal treatment:		_ Conduct	ive						
		<u>x</u>	Electrica	al Resistance						
			_	3 phase		_ 6 phase	AC	power	DC	power
		_	_ Steam							
			_	Steam		_ Steam + air	Ste	am + O2		
		_	Other (d							
<u>X</u>	Type of Test:		t test	_	scale Systen					
<u>X</u>	Geology of Treatment Zone	э:				ous and perme				
			·			ous and imper				
			<u>X</u>						-	ability material
			_						of nigher peri	meability material
			_			ured bedrock (i	•	e rock)		
	_ Treatment Targe Zone:		 Saturate			limestone, san		th (Saturata	nd and Vadose	zones)
	Start of Thermal Test:		_ Saturati 5/2006	eu only	Vad	-	Boi			
<u>X</u>	Hydraulic Control		_ Yes	No		Duratio				_
	_ riyaraane control		_ 103	110						
<u>X</u>	Treatment Cell Design:									
_	Size of target zone (ft2):							Unknow	vn (_ x ft)
	Thickness of target zone (f	t):						Unknow		
	Depth to top of target zone	(ft bo	js):				_	Unknow	vn	
	Thickness of target zone b	elow v	water tabl	le (ft):				Unknow	vn	
	Number of energy delivery	point	s:					Unknow	vn	
	Number of extraction point	s:						Unknow	vn	
<u>X</u>	Temperature Profile:									
	Initial formation temperatur					<u>18.3</u>		_	Unknow	
	Maximum representative for		-					-	Unknowi	
	Time to reach maximum re					-			Unknow	
	Duration of treatment at re	prese	ntative tei	mperature (da)	ys):			_	Unknowi	1
						D	ate		Temperatu	re (dea C)
	Formation temperature imr	nedia	tely post-	treatment:		_				
	Formation temperature pos				1:					
	Duration of post-treatment			-				_		
<u>X</u>	Mass of contaminant remo	ved:								
	Via	liquid	pumping:				lb	_	kg	Unknown
	In va	apor s	stream:	-			lb	_	kg	Unknown
	Tota	ıl:					lb	_	kg	Unknown
	Commente									
	Comments:									
	Attachments:							-		

Cos	st and Performance					Facility ID#:	<u>0742</u>
	_ Performance						
	Remediation Goal:						
		In Groundwater: _					
		In Soil:					
		·					
	Was the Remediation	on Goal Achieved:					
		In Groundwater					
		Comment: -					
			_				
		In Soil					
		Comment:					
		_					
	General comments	on the thermal applica	ation:				
	Lessons Learned						
							
Y	Energy						
<u>X</u>	Total Energy Used:			kWhr	k\\/hr/m³	le.	Whr/ud ³
			reatment zone.	KWIII		kWhr/m ³	kWhr/yd ³
		tal energy applied to t	reatment zone:				
	Otr	ner energy:				_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
X	Cost						
_	Total Project Cost:						
	·	nsultant Cost:					
		ermal Vendor Cost:	-		m ³	v.d ³	
	<u> </u>	ergy Cost:			m ³	_yd ³	
		ner Cost 1:					
		ner Cost 2:	<u></u>				
		ner Cost 3:					
	Please note of	ther cost:	Other Cost 1:				
		_	Other Cost 2:				

____ Other Cost 3:

File Analyzed By: <u>X</u> PD ____ Date: 5/4/2005 Type of treatment: Conductive <u>X</u> Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: Active Post X Type of Test: Pilot Test Full Scale System Start of Test: 9/10/2000 End of Test: 9/28/2001 Duration: 365 d Type of Site: Non-DOD __ DoD Facility Name: Savannah River Site Address: City, State, Zip Code: Aiken, SC OU# or Site #: 321-M Solvent Storage Area Primary point of contact: Jim Kupar Organization: Bechtel Savannah River, Inc. Address: Bldg. 730-4B, Rm 3029 City, State, Zip Code: Aiken, SC 29808 Phone #: 803-952-6525 email: james.kupar@srs.gov Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: Vendor, Consultant ____Other Organization: Address: City, State, Zip Code: Phone #: email: _ QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0750

General Site Information

___ Hydraulic Conductivity information

X Impacted	X Impacted zone a	w direction)(ft.): ≥25000 is defined by documentation od for determining size of im			ness (ft): <u>160</u>		Unknown					
Monitor V	Wells: Number of relevant m	nonitoring wells with groundy	vater data: Pre-treatment	:	Post-treatment:		None					
	Number of wells relat	ive to treatment zone:										
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:						
	Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:						
				· ·								
Soil Borings: Number of relevant soil borings with pre-treatment data:												
	Number of relevant so	il borings with post-treatmen	nt data:									
	Number inside treatme	ent zone:	Number outsid	le treatment zone:								
X Types of 0	Contaminants											
				Average Pre-treatme	ent Concentration per	Average Post-treatm Cher	ent Concentration per					
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)					
	X Trichloroethene	Hexane	Creosote	None None	None None	None None	None None					
	X Tetrachloroethene	Jet Fuel	Creosote	None	None	None	None					
	1,1-dichloroethene											
		Napthalene		None	None	None	None					
		Benzene		None	None	None	None					
	trans-1,2-dichloroethene	Tolune		None	None	None	None					
	1,1-dichloroethane	Ethylbenzene		None	None	None	None					
	1,2-dichloroethane	m/p-xylene		None	None	None	None					
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None					
Concern	1,1,2-trichloroethane			None	None	None	None					
	1,1,2,2-tetrachloroethane			None	None	None	None					
	Vinyl Chloride			None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
Comme	Comments:											
			-									
Attachmer	nts:											

0750

General Site Assessment Data

Hyd	Irogeologic Conceptu	al Model		Facility ID#: 0750						
<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>							
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated se	ediments						
			Relatively homogeneous and impermeable unconsolidated	sediments						
			\underline{X} Largely permeable sediments with inter-bedded lenses of lower permeability material							
			Largely impermeable sediments with inter-bedded layers o	higher permeability material						
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments							
			Relatively homogeneous and impermeable unconsolidated sediments							
			\underline{X} Largely permeable sediments with inter-bedded lenses of \mathbb{R}^2	ower permeability material						
			Largely impermeable sediments with inter-bedded layers o	higher permeability material						
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
_	_ Ground surface ele	vation based on wells in o	adjacent to treatment zone: ft amsl	Unknown						
X	Aquifer Characteris	tics:								
	Is more than 1 aqui	ifer present?	-	Inknown (assume single aquifer)						
			Aquifer 1 Aquifer 2 Aquifer 3							
	Depth to water:	low value (ft bgs):	<u>135</u> <u>160</u>	-						
		high value (ft bgs):	145	-						
		Unknown:		-						
_	_ Flow direction			-						
		c gradient (feet/foot):		Unknown						
	Vertical hydraulic g	radient (feet/foot):		Unknown						
v	V range (ft/day)	Macaurad	roing: Clug Toot Laborators V	' E:-14 J						
<u>X</u>	K range (ft/day)	Measured	· — · — ·	•						
		low	<u></u>	Unknown						
	Transmississis (#2/	high day): Measured	using:Slug Test Laboratory	- Field data						
	Transmissivity (ft2/	• /	using Slug rest Laboratory							
		low		Unknown						
		high		_						
	Comments:									

Average K=0.4 ft/min

Attachments:

The	ermal Treatment - Desig	gn							Faci	lity ID#:	0750	
<u>X</u>	Thermal treatment:		Conduc	tive								
			Electric	al Resistance								
			_	3 phase		6 phase	_	AC po	wer	DC	power	
		<u>X</u>	Steam									
			_	Steam		Steam + air	-	Steam	+ O2			
			Other (c	lescribe)								
<u>X</u>	Type of Test:	_	ot test	Full-	-							
<u>X</u>	Geology of Treatmen	nt Zone:	_		_	eneous and per						
			_			eneous and imp						
			<u>X</u>			le sediments wit				-	-	
			-			able sediments			-	igher perm	eability	material
			-			ractured bedroc		-	CK)			
.,	T T . T		_			ock, limestone, s						
<u>X</u>	Treatment Targe Zor			ed only		Vadose only			saturated a	ind Vadose	zones)	
<u>X</u>	Start of Thermal Test		0/2000	N.		Dura	ition: 3	65 <u>d</u>				
<u>X</u>	Hydraulic Control	_	Yes	No								
<u>X</u>	Treatment Cell Desig	ın:										
_	Size of target zone (f				10,000	<u>)</u>			Jnknown	(х	ft)
	Thickness of target z				140				Jnknown			
	Depth to top of target	t zone (ft b	gs):		<u>20</u>				Jnknown			
	Thickness of target z	one below	water tab	le (ft):	<u>15</u>				Jnknown			
	Number of energy de	elivery poir	nts:		9				Jnknown			
	Number of extraction	points:			<u>4</u>				Jnknown			
<u>X</u>	Temperature Profile:											
_	Initial formation temp		eq C):			<u>20</u>				_ Unknown		
	Maximum representa			erature (deg C):	<u>100</u>				_ _ Unknown		
	Time to reach maxim	ium repres	entative te	emperature (da	ays):	<u>180</u>				_ _Unknown		
	Duration of treatment	t at repres	entative te	mperature (da	ys):	<u>185</u>				_ Unknown		
							<u>Date</u>		<u>I</u>	- emperatur	e (deg C	<u>)</u>
	Formation temperatu	re immedi	ately post-	treatment:		10/1/2001			99			
	Formation temperatu	re post-tre	atment m	onitoring even	t 1:	11/2/2001			<u>90</u>			
	Duration of post-treat	tment mon	nitoring (da	nys):								
<u>X</u>	Mass of contaminant	removed:										
		Via liquid	d pumping	:			-	lb		_ kg		Unknow
		In vapor	stream:				-	lb	-	_ kg		Unknow
		Total:			3	31,000	-	lb	<u>X</u>	kg		Unknow
	Comments:											
						usters of wells vo	with ste	am injecti	on wells	in each cl	uster wi	th_
	Attachments:			-		-						

Cos	st and Performance			Fa	cility ID#:	<u>0750</u>
	_ Performance					
	Remediation Goal:					
	In Groundwater:					
	in croundwater.					
	In Soil:					
	11 30 .					
	Was the Remediation Goal Achieved:					
	In Groundwater					
	- Comment: -					
	-					
	In Soil					
	Comment:					
	Comment.					
	-					
	General comments on the thermal applic	cation:				
	Steam injected - 4.5x10E10) BTU	s (13188198.2 kw-hr).	Objectives: 1) con	taminants removed fro	om target so	urce area; 2)
	target zone must be heated to app	lied boiling point; 3)	Air to support HPO m	ust be injected into tre	atment zon	<u>e</u> .
	Lessons Learned					
	-					
	_					
<u>X</u>	Energy					
	Total Energy Used:		kWhr		kW	•
	\underline{X} Total energy applied to	treatment zone:	13188198 kw-hr	kW	/hr/m ³	kWhr/yd ³
	Other energy:			kW	/hr/m³	kWhr/yd ³
	Please	e note other energy:				
<u>X</u>	Cost					
	Total Project Cost:	\$29 / yd3				
	Consultant Cost:					
	Thermal Vendor Cost:					
	Energy Cost:			_ m³ yd ³	3	
	Other Cost 1:					
	Other Cost 2:					
						
	Other Cost 3:					
	Please note other cost:	Other Cost 1:				
		Other Cost 2:				
	-	Other 00st 2.	-			

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/11/2006
_	Type of treatment:	Conductive		_ Steam	ERH	<u>x</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	 X Chlorinated Sol 			Petroleum Hyd	_	ons	Pesticides	
	•	Wood Treating			Other:				
	Treatment Status:	Active	X	Post	_				
	Type of Test:	x Pilot Test		Full Scale	System				
	Start of Test:	3/25/1993		End o	of Test: 4/26/199	13		Duration: 27 d	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: Savannah	River Site							
	Address:								_
	City, State, Zip Code:	Aiken, SC							
	OU# or Site #: Site 321 M	1-Area Seepage Basin							
<u>X</u>	Primary point of contact:	www.osti.gov/bridge		doc	no.: WSRC-TR	<u>-93-673</u>	=		
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:			email:					
	Osh	h			N				
	Other contacts or vendors wh	no worked on site			None				
	Point of contact:			d Tb			041		
	Type: Vendor, Co	onsultant			al Applications		Oth		
	· =====								
	Address:								
	City, State, Zip Code:								
	Phone #:		-	eman:					
Q,	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	eatment groundwater dat	a		Good pro	e- and p	ost-treatme	nt soil data	
	Good temperature prof	file vs. time information			Flux asse	essment			
	Groundwater elevation	ıs			Geologic	cross-s	section		
	Hydraulic Conductivity	y information							

<u>0760</u>

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0760</u>	
Impacted	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):	<u> </u>	Unknown	
	Impacted zone a	s defined by documentation						
	Alternative method	od for determining size of im	pacted zone (See source zo	ne definition attachmen	its)			
	Map attachment							
x Monitor V	Vells: Number of relevant m	nonitoring wells with grounds	vater data:				None	
			Pre-treatment:	<u>20</u>	Post-treatment:	<u>20</u>		
	Number of wells relati							
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:		
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
<u>x</u> Soil Boring	as: Number of relevant so	il borings with pre-treatment	data: <u>10</u>					
	=	il borings with post-treatmen						
	Number inside treatme			treatment zone:	0			
					=			
x Types of C	Contaminants							
				Average Pre-treatme	nt Concentration per	Average Post-treatme	ent Concentration per	
				Chen		Chemical:		
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	X Trichloroethene	Hexane	Creosote	None	None	None	None	
	<u>x</u> Tetrachloroethene	Jet Fuel		None	None	None	None	
	1,1-dichloroethene	Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	Benzene		None	None	None	None	
	trans-1,2-dichloroethene	Tolune		None	None	None	None	
	1,1-dichloroethane	Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	m/p-xylene		None	None	None	None	
Chemicals of	x 1,1,1-trichloroethane	o-xylene		None	None	None	None	
Concern	1,1,2-trichloroethane			None	None	None	None	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
Comme	nto:							
Conine								
			-					
Attachmer	nts:							
, addinine								

Hyd	Irogeologic Conceptua	I Model					Facility ID#	#: <u>0760</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	X Relatively Largely p Largely in Competer Weathere Relatively Relatively Largely p Largely in Competer	w homogeneous whomogeneous ermeable sedim inpermeable sed int, but fractured and bedrock, lime whomogeneous whomogeneous ermeable sedim inpermeable sed int, but fractured int, but fractured	and permeable un and impermeable ients with inter-be liments with inter-b bedrock (i.e. cryst stone, sandstone and permeable un and impermeable ients with inter-be liments with inter-be bedrock (i.e. cryst stone, sandstone	unconsolidated s ided lenses of lovedded layers of lealline rock) consolidated secunconsolidated s ided lenses of lovedded layers of leaded l	ediments wer permeabil nigher permea liments ediments wer permeabil	ability material
<u>x</u>		ration based on wells in or			<u>360</u>	ft amsl		Unknown
X	Aquifer Characteristi		No	Yes (number):	<u>x</u> Un Aquifer 3	known (assumo	e single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:						
	_ Flow direction							
<u>x</u>	Horizontal hydraulic Vertical hydraulic gra	, ,					<u>x</u>	Unknown Unknown
<u>x</u>	K range (ft/day)	Measured of low high	using:	_ Slug Test	Laborator	y	Field data <u>X</u>	Unknown
	Transmissivity (ft2/d	_	using:	_ Slug Test	Laborator	y	Field data	Unknown
	Comments:							

Attachments:

The	ermal Treatment - Des	sign								Facil	ity ID#:	0760	
X	Thermal treatment:		Conductive										
		Electrical Resistance											
			_	3 phase		6 pha	se		AC power		D	C power	
			Steam										
			_	Steam		Stean	n + air	S	Steam + O2	2			
		<u>x</u>	Other (de	escribe)	RFH								
<u>x</u>	Type of Test:	<u>x</u> Pil	ot test	Full	-scale S	System							
<u>x</u>	Geology of Treatme	ent Zone:	_	Relatively	/ homo	geneous ar	nd permeat	ole unco	nsolidate	d sedii	ments		
			<u>x</u>	Relatively	/ homo	geneous ar	nd imperme	eable un	consolida	ted se	diments		
			_	Largely p	ermea	ble sedimer	nts with inte	er-bedde	ed lenses	of low	er perme	eability m	naterial
			_	Largely in	nperm	eable sedim	ents with i	nter-bed	lded layer	s of hi	gher pe	rmeabilit	y material
			_	Compete				-	ine rock)				
			_	Weathere	ed bed	rock, limesto	one, sands	tone					
<u>X</u>	Treatment Targe Z	one:	Saturate	ed only	<u>x</u>	Vadose only	y	I	Both (Satur	ated ar	nd Vados	e zones)	
<u>X</u>	Start of Thermal Te	est: <u>3/2</u>	25/1993				Duration:	<u>27 d</u>					
	_ Hydraulic Control	_	Yes	No									
<u>x</u>	Treatment Cell Des	sian:											
~	Size of target zone	_			3000				Unkr	own	(30 x	<u>10</u> ft)
	Thickness of target				10			_	Unkr				
	Depth to top of targ		ogs):		35			_	Unkr				
	Thickness of target			e (ft):					Unkr	own			
	Number of energy			` '	1				Unkr				
	Number of extraction	on points:			1			_	Unkr	iown			
<u>x</u>	Temperature Profile	e:											
	Initial formation ten	nperature (d	eg C):			<u>20</u>					Unknow	'n	
	Maximum represer	tative forma	ition tempe	rature (deg C	:):	<u>65</u>					Unknow	'n	
	Time to reach maxi	imum repres	sentative te	mperature (d	ays):	<u>27</u>					Unknow	'n	
	Duration of treatme	ent at repres	entative ter	mperature (da	ays):	<u>1</u>					Unknow	'n	
							Date	<u> </u>		<u>Te</u>	emperat	ure (deg	<u>C)</u>
	Formation tempera	ture immedi	ately post-t	reatment:									
	Formation tempera	ture post-tre	eatment mo	nitoring even	nt 1:				_				
	Duration of post-tre	atment mor	nitoring (day	/s):					_				
<u>x</u>	Mass of contamina	nt removed:											
_		Via liqui	d pumping:					1	b		kg	<u>x</u>	Unknow
		In vapor						1			kg	<u>_</u>	Unknow
		Total:				<u>171.5</u>				<u>x</u>	kg		Unknow
	Comments:												
	SI	hut down fo	or 7 days										
	Attachments:												

Cost	t and Performanc	е				Facility ID#:	<u>0760</u>
	_ Performance						
	Remediation Go	oal:					
		In Groundwat	er: —				
		In Soil: —					
		_					
	Was the Remed	diation Goal Achieved					
		In Groundwat					
		Comme	nt: —				
		la Call					
		In Soil	. —				
		Comme	nt:				
	General comme	ents on the thermal a	pplicat	ion:			
	Of the 21	200 kWhr upod only	GE0/ \	was converted to ED pe	ower in which only 959/	went into the formation	
						·	
	Objectives reduced o	s: 1) Simple installat ost over comparable	ion, sta	art up, and trouble free	operation 2) acc	celerated TCE and Pce vola mance with treatability stud	tilization 3)
	predictive		toonin	ologico and if con	Torridated of Hold portor	manoo wan araaaanay otaa	ioo ana oompator
	Lessons Learne	ed					
							
<u>x</u>	Energy						
_	Total Energy Us	sed: 21	200		x kWhr	kWhr/m³ kV	Vhr/yd ³
	<u>x</u>		d to tre	eatment zone:		kWhr/m³	
	-	Other energy:				kWhr/m ³	
			ease n	ote other energy:		<u> </u>	
				3,			
<u>x</u>	Cost						
	Total Project Co	ost:		<u>853994</u>			
		Consultant Cost:					
		_ Thermal Vendor Co	ost:	-			
	<u>x</u>	Energy Cost:		<u>11020</u>	m ³	yd ³	
	<u>x</u>	Other Cost 1:		<u>245867</u>			
	<u>x</u>	Other Cost 2:		<u>241390</u>			
	<u>x</u>	Other Cost 3:		<u>366737</u>			
	x Please no	te other cost:	<u>x</u>	Other Cost 1:		Rf delivery	
			<u>x</u>	Other Cost 2:		field support	
			<u>x</u>	Other Cost 3:	off-gas treatmen	nt/well prep and monitoring/	analytical

File Analyzed By: JT	<u>x</u> PD				Date:	8/20/2007
Type of treatment:	<u>x</u> Conductive	Steam	ERH _	Other:		
Type of Contaminant:	x Chlorinated Solv	vents	Petroleum Hydroca	rbons	Pesticides	
	Wood Treating		Other:			
Treatment Status:	Active	<u>x</u> Post				
Type of Test:	Pilot Test	x Full Scale	System			
Start of Test:	1/29/2007	End	of Test: <u>6/20/2007</u>		Duration: 142	
Type of Site:	x Non-DOD	DoD				
Yes Facility Name: South Eas	stern US					
Address: City, State, Zip Code:	South Eastern US					_
OU# or Site #:						_
Primary point of contact:	Ralph Baker					
Organization: <u>TerraTher</u>	•					
Address: 10 Stevens Road	<u>d</u>					
City, State, Zip Code:	Fitchburg, MA 01420					
Phone #: <u>978-343-0300</u>		email: rbal	xer@terratherm.com			
Other contacts or vendors w	ho worked on site		None			
Point of contact:						
Type: Vendor, C	Consultant	_ Vendor, Techni	cal Applications	Othe	er	
Organization:						
Address:						
City, State, Zip Code:						
Phone #:		email:				
04/00						
QA/QC						
Characteristics of Interest	t					
Good pre- and post-tre		a	Good pre- and	d post-treatmen	t soil data	
Good temperature pro:			Flux assessme			
Groundwater elevation			Geologic cros			
Hydraulic Conductivit			_ _			

0765

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0765</u>
Impacted	Zone: Length (parallel to flow Impacted zone a Alternative meth Map attachment	xness (ft): 87		Unknown			
Monitor V	Vells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:	<u>8</u>	Post-treatment:	<u>7.</u>	None
	Number of wells relat	ive to treatment zone:					
	Pre-treatment	In: <u>4</u>	Upgradient:	Downgradient:	<u>4</u> Cros	ssgradient:	
	Post-treatment	In: <u>3</u>	Upgradient:	Downgradient:	<u>4</u> Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data: <u>11</u>				
	Number of relevant so	il borings with post-treatmer	nt data: <u>6</u>				
	Number inside treatme	ent zone: 6	Number outsid	e treatment zone:			
Types of C	Contaminants		1	T		Т	
					ent Concentration per mical:		ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	X Trichloroethene	Hexane	Creosote	1,000 mg/L	100 mg/kg	0.005 mg/L	0.01 mg/kg
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	nts:						
			-				
Attachmen	nts:						

Hydrogeologic Conce	ptual Model									Facility II	D#: <u>076</u>
Geology:	Zor Vadose z Saturate	Zone:	<u>Uncor</u> <u>X</u> <u>X</u> <u>X</u> X	Relatively Largely ir Compete Weathere Relatively Relatively Largely ir	y homo y homo permeal mperme ent, but ed bedr y homo y homo permeal mperme ent, but	geneous geneous ble sedin eable sed fractured cock, lime geneous geneous ble sedin eable sed fractured	and imponents with diments vill bedrock estone, so and perronant imponents with diments vill bedrock	ermeable in inter-bed with inter-bed with inter-bed andstone meable un ermeable in inter-bed with inter-bed with inter-bed it. (i.e. cryst	dded lenses o pedded layer: alline rock) consolidated unconsolidat dded lenses o	ted sediments of lower permeal s of higher perm	eability material
	elevation based	I on wells in o					<u>897</u>		ft amsl	_	Unknown
Aquifer Charact	eristics:										
Is more than 1 a	aquifer present?	<u>X</u>	No		Ye	s (number	·):			_ Unknown (assur	me single aquifer)
			P	Aquifer 1		A	Aquifer 2		Aquifer 3	;	
Depth to water:		e (ft bgs):	<u>55</u>								
	_	ie (ft bgs):	<u>65</u>							_	
	Unknowr	1:									
Flow direction			<u>SW</u>								
Horizontal hydr	aulic gradient (fe	et/foot):	0.03								Unknown
-	-										Unknown
vertical flydraul	ic gradient (feet/	1001).	0.04								Unknown
K range (ft/day)		Measured low	using:	_	Slug	Test		Laborator	у	Field data	Unknown
high Transmissivity (ft2/day): Measured low			0.28 using:	: <u></u>	_ Slug	Test		Laborator	у	Field data	Unknown
Comments:										capture and to	enhance natural
Attachments:											

The	rmal Treatment - Design										Facil	lity ID#:	076	<u>5</u>
<u>x</u>	Thermal treatment:	<u>X</u>	Condu	ctive	In Si	tu The	rmal Desorption	<u>on</u>						
		Electri	cal Resi	istance										
			-	3	phase		6 phase	;		_ AC pov	wer	D	C power	
			Steam	_										
			-	St	team		Steam	+ air		_ Steam	+ O2			
			Other (describ	e)									
<u>x</u>	Type of Test:	_ Pilot	test	<u>X</u>	Full-	scale S	System							
<u>X</u>	Geology of Treatment Zone	e:	2	X R	elatively	homo	geneous and	perme	able un	consolid	lated sedi	iments		
			-	R	elatively	homo	geneous and	impern	neable	unconso	olidated se	ediments		
			-	La	argely pe	ermeal	ble sediment	s with in	iter-bed	lded lens	ses of low	er perme	eability r	material
			-		argely im	perm	eable sedime	nts with	inter-b	edded la	ayers of h	igher per	meabili	ty material
							fractured bed		-	alline ro	ck)			
			· -				ock, limestor	ie, sand	Istone					
<u>X</u>	Treatment Targe Zone:		-	ated on	ly		Vadose only		<u>X</u>	Both (S	Saturated a	nd Vados	e zones)	
<u>X</u>	Start of Thermal Test:		2007				I	Duration	i: <u>142</u>					
X	Hydraulic Control	<u>X</u>	Yes	_	No									
<u>x</u>	Treatment Cell Design:													
	Size of target zone (ft2):					2554				t	Jnknown	(<u>33</u> x	<u>76</u> ft)
	Thickness of target zone (f	t):				<u>87</u>				t	Jnknown			
	Depth to top of target zone	(ft bg	s):			0				t	Jnknown			
	Thickness of target zone be	elow v	vater ta	ble (ft):		<u>35</u>				t	Jnknown			
	Number of energy delivery	points	s:			<u>24</u>				t	Jnknown			
	Number of extraction points	s:				<u>10</u>				^t	Jnknown			
<u>x</u>	Temperature Profile:													
_	Initial formation temperatur	e (dec	a C):				<u>20</u>					_ Unknow	'n	
	Maximum representative for			erature	e (deg C):	101					Unknow		
	Time to reach maximum re		-				75					Unknow		
	Duration of treatment at rep			•	,	• /	65					Unknow		
				·	,	• •	_				· ·	_		
								Da	ate_		<u>T</u>	emperati	ure (deg	1 C)
	Formation temperature imp	nediat	ely pos	t-treatn	nent:		6/18/20	007			<u>100</u>			
	Formation temperature pos	st-trea	tment m	nonitori	ng event	1:	7/15/20	007			<u>90</u>			
	Duration of post-treatment	monit	oring (d	ays):			<u>365</u>							
	_ Mass of contaminant remo	ved:												
	Via	liquid	pumpin	g:						_ lb		kg		Unknow
	In va	apor s	tream:				11,550		<u>X</u>	lb		kg		Unknow
	Tota	al:					11,550			_ lb		_ kg	_	_ Unknow
	Comments:													
	Attachments:													

Cost and Performance				Fac	cility ID#:	<u>0765</u>
Performance						
Remediation Goal	:					
_	In Groundwater:					
_						
X	(In Soil:					
_		95% UCL	. of mean TCE con	ncentration must be <0.0)60 mg/kg	
Was the Remedia	tion Goal Achieved:					
_	In Groundwater					
	Comment:					
<u>x</u>	In Soil					
	Comment:					
		95% UCL of mean TCE	concentration = 0.	.017 mg/kg		
General comment	s on the thermal appl	ication:				
	s on the thermal appl					
Lessons Learned						
Energy						
Total Energy Used	d: <u>1860</u>	600	X kWhr	kWhr/m ³	kWh	nr/yd ³
	otal energy applied to		<u> 1776600</u>	kW		kWhr/yd ³
	Other energy:		84000	kW		kWhr/yd ³
 `		se note other energy:	<u>0.000</u>	misc. motors,		
	1 1643	se note other energy.		misc. motors,	<u>Jumps</u>	
Cost		ont good not wen to				
Total Project Cost		ent ages not wish to close the cost of the				
c	Consultant Cost:					
	hermal Vendor Cost:					
	energy Cost:			m ³ yd ³		
	Other Cost 1:			,		
	Other Cost 1:					
	Other Cost 3:	Oth 2				
Please note	otner cost:	Other Cost 1:				
		Other Cost 2:				
		Other Cost 3:				

File Analyzed By: PD ____ Date: 10/11/2006 ____Steam ____Other: Type of treatment: Conductive Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating _Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: 6/13/1995 End of Test: 7/8/1995 Duration: 26 d Type of Site: DoD ___Non-DOD Facility Name: Oak Ridge Reservation Address: City, State, Zip Code: Oak Ridge, TN OU# or Site #: Site K-25 Primary point of contact: OSTI.gov/bridge document #: DOE/OR/22160-T22 vol 1 & 2 Organization: Address: City, State, Zip Code: Phone #: email: ____ Other contacts or vendors who worked on site ____ None Point of contact: Vendor, Consultant _____ Vendor, Technical Applications Type: ____Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0768

General Site Information

___ Hydraulic Conductivity information

<u>x</u> Impacted			Width (ft):	Thick	ness (ft):		<u>x</u> Unknown				
		as defined by documentation									
		od for determining size of im	pacted zone (See source zo	one definition attachmer	its)						
	Map attachment										
Monitor \	Wells: Number of relevant n	nonitoring wells with ground	vater data:				None				
			Pre-treatment:		Post-treatment:						
	Number of wells relat	tive to treatment zone:									
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:					
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:					
Soil Borings: Number of relevant soil borings with pre-treatment data:											
		Number of relevant soil borings with post-treatment data:									
	Number inside treatme	= "		e treatment zone:							
			_								
x Types of 0	Contaminants										
,,,				Average Pre-treatme	ent Concentration per		ent Concentration per nical:				
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	x Trichloroethene	Hexane	Creosote	None	0.01 mg/kg	None	0.01 mg/kg				
	<u>x</u> Tetrachloroethene	Jet Fuel		None	0.01 mg/kg	None	0.01 mg/kg				
	1,1-dichloroethene	Napthalene		None	None	None	None				
	cis-1,2-dichloroethene	Benzene		None	None	None	None				
	trans-1.2-dichloroethene	x Tolune		None	0.01 mg/kg	None	0.01 mg/kg				
	1,1-dichloroethane	Ethylbenzene		None	None	None	None				
	1,2-dichloroethane	m/p-xylene		None	None	None	None				
	x 1,1,1-trichloroethane	o-xylene		None	0.01 mg/kg	None	0.01 mg/kg				
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None				
Concern	1,1,2,2-tetrachloroethane			None	None	None	None				
	Vinyl Chloride			None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
Comme	ents:										
Attachme	nts:										

0768

General Site Assessment Data

Hyd	rogeologic Conceptual	Model				Facility ID#	‡: <u>0768</u>	
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone					
<u>x</u>	Ground surface eleva	ation based on wells in or	adjacent to trea	tment zone:	ft amsl	<u>x</u>	Unknown	
X	Aquifer Characteristic Is more than 1 aquife Depth to water:		No Aquifer 1	Yes (number):Aquifer 2	Aquifer 3	nknown (assume 	e single aquifer)	
<u>x</u>	Flow direction					_		
<u>x</u>	Horizontal hydraulic ç Vertical hydraulic gra					<u>x</u>	Unknown Unknown	
<u>x</u>	K range (ft/day) Transmissivity (ft2/da	Measured of low high ny): Measured of low high		Slug Test Labora		Field data X Field data X X	Unknown Unknown	
	Comments:							

Ther	rmal Treatment - Design							Facility ID#:	<u>0768</u>
<u>x</u>	Thermal treatment:		Conductiv	e					
		<u>x</u>	Electrical	Resistance					
				_ 3 phase		6 phase	AC	power	OC power
			Steam	Steam		Steam + air	Ste	am + O2	
			Other (des	cribe)					
<u>x</u>	Type of Test: <u>x</u>	Pilot	test	Full	l-scale S	ystem			
<u>x</u>	Geology of Treatment Zone	e:		_ Relatively	y homo	geneous and pern	neable uncons	solidated sediments	
			<u>x</u>	Relatively	y homo	geneous and impe	ermeable unco	nsolidated sediment	3
				_ Largely p	ermea	ole sediments with	n inter-bedded	lenses of lower perm	eability material
				_ Largely ir	mperm	eable sediments w	vith inter-bedde	ed layers of higher pe	rmeability material
				_ Compete	nt, but	fractured bedrock	(i.e. crystalline	e rock)	
				_ Weather	ed bedi	ock, limestone, sa	andstone		
<u>x</u>	Treatment Targe Zone:		Saturated	donly	<u>x</u>	Vadose only	Bot	th (Saturated and Vado	se zones)
<u>x</u>	Start of Thermal Test:	6/13/	1995			Durati	ion: <u>26 d</u>		
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No					
<u>x</u>	Treatment Cell Design:								
	Size of target zone (ft2):				400			Unknown (25 x 16 ft)
	Thickness of target zone (ft):			<u>20</u>			Unknown	
	Depth to top of target zone	(ft bgs	s):		0			Unknown	
	Thickness of target zone be	elow w	ater table	(ft):	<u>0</u>			Unknown	
	Number of energy delivery	points	:		31			Unknown	
	Number of extraction points	3:			<u>4</u>			Unknown	
<u>x</u>	Temperature Profile:								
_	Initial formation temperature	e (deg	(C):			<u>18</u>		Unknow	vn
	Maximum representative fo	rmatic	on tempera	ature (deg C	C):	<u>75</u>		Unknow	vn
	Time to reach maximum rep	preser	ntative tem	perature (d	lays):	<u>25</u>		Unknow	vn
	Duration of treatment at rep	resen	tative tem	perature (d	ays):	<u>1</u>		Unknow	vn
							<u>Date</u>	<u>Tempera</u>	ture (deg C)
	Formation temperature imm	nediate	ely post-tre	eatment:					
	Formation temperature pos	t-treat	ment mon	itoring ever	nt 1:	-			
	Duration of post-treatment	monito	oring (days	s):					
<u>x</u>	Mass of contaminant remov	/ed:							
	Via I	iquid p	oumping:				lb	kg	Unknown
	In va	por st	ream:	_			lb	kg	Unknown
	Tota	l:					lb	kg	<u>x</u> Unknown
	Comments:								
	<u> </u>								
	Attachments:								

Cos	st and Performance					Facility ID#:	<u>0768</u>
<u>x</u>	Performance						
_	Remediation Goal:						
		In Groundwater: —					
		_					
	<u>x</u>	In Soil:	05 05.0 0			. 0) "	
		<u>1) Hea</u> samples	s 4) measu	neasure extra ire energy	5) measure	ate 3) collect and cond temperature distrubution	ense extracted gas with time and energy
	Was the Remediation (Goal Achieved:					
		In Groundwater					
		Comment: —					
		In Soil					
		Comment: —					
	General comments on	the thermal applica	tion:				
	Cost was \$144/to	nn.					
	Oost was \$11 mts	<u></u>					
	Lessons Learned						
<u>X</u>	Energy						
	Total Energy Used:	<u>25900</u>		<u>x</u> k	Whr	kWhr/m ³ kV	
	Total	energy applied to tr	eatment zone:			kWhr/m ³	kWhr/yd ³
	Other	energy:				kWhr/m ³	kWhr/yd ³
		Please i	note other energy:				
	Cont						
_	_ Cost						
	Total Project Cost:						
		ultant Cost:					
	· · · · · · · · · · · · · · · · · · ·	nal Vendor Cost:			2	.3	
		gy Cost:			m ³	yd ³	
	Other		-				
	Other	Cost 2:					
	Other	Cost 3:					
	Please note othe	r cost:	Other Cost 1:				
			Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	11/14/2006
	Type of treatment:	Conductive	Steam	<u>x</u> ERH	Other:		
	Type of Contaminant:	<u>x</u> Chlorinated Solve	ents _	Petroleum Hydro	ocarbons	Pesticides	
		Wood Treating	_	Other:			
	Treatment Status:	Active	<u>x</u> Post				
	Type of Test:	<u>x</u> Pilot Test	Full Sca	ıle System			
	Start of Test:	8/7/2000	En	d of Test: <u>11/5/2000</u>		Duration: 88d	
	Type of Site:	Non-DOD	DoD				
<u>x</u>	Facility Name: <u>Air Force</u>	Plant 4					
	Address:						_
	City, State, Zip Code:	Ft. Worth, TX					
	OU# or Site #: Building	181					
<u>x</u>	Primary point of contact:	George Walters					
-	Organization: Air Force	_					
		01 Tenth St., Suite 2					
	City, State, Zip Code:	Wright-Patterson AFB,					
	Phone #: 937-255-1988			eorge.walters@wpafb	.af.mil		
<u>X</u>	Other contacts or vendors w			None			
		ig Holloway	V T	-:1 A1:4:	Od		
	Type: <u>x</u> Vendor, 0 Organization: <u>URS</u>	Consultant	vendor, rech	nical Applications	Oth	ier	
	Address: 9400 Ambergle	n Poulovard					
	City, State, Zip Code:	Austin, TX 78729					
	Phone #: 512-454-4797	Austili, 1A 78725	email: cı	aig_holloway@ursco	ırn com		
	1 Hone #. <u>512-454-4777</u>		cman. <u>cr</u>	arg_nonoway @ ursec	тр.сош		
Q	A/QC						
	_ Characteristics of Interes	t					
	Good pre- and post-tr	eatment groundwater data		Good pre-	and post-treatme	nt soil data	
	Good temperature pro	ofile vs. time information		Flux assess	sment		
	Groundwater elevatio	ns		Geologic c	ross-section		
	Hydraulic Conductivi	ty information					

0770

General Site Information

<u>x</u> Impacted	Impacted zone a	w direction)(ft.): 1250 as defined by documentation od for determining size of im	Width (ft): pacted zone (See source z	_	eness (ft): 30		Unknown					
<u>x</u> Monitor	Wells: Number of relevant n	nonitoring wells with groundw	vater data:				None					
_		J	Pre-treatment:	: 10	Post-treatment:	<u>10</u>						
	Number of wells relat	tive to treatment zone:										
	Pre-treatment	In: <u>8</u>	Upgradient:	Downgradient:	<u>2</u> Cro	ssgradient:						
	Post-treatment	In: <u>8</u>	Upgradient:	Downgradient:	<u>2</u> Cro	ssgradient:						
x Soil Borings: Number of relevant soil borings with pre-treatment data: 3												
<u>x</u>	=	oil borings with post-treatmen										
Number inside treatment zone: 3 Number outside treatment zone: 3												
	Number inside treatment zone: 3 Number outside treatment zone: 3											
x Types of	Contaminants											
					ent Concentration per		ent Concentration per					
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	nical: Soil (mg/kg)	Groundwater (mg/L)	mical: Soil (mg/kg)					
	 X Trichloroethene 	Hexane	Creosote	50 mg/L	10 mg/kg	5 mg/L	0.5 mg/kg					
	Tetrachloroethene	Jet Fuel	Creosote	None	None None	None	None None					
	1,1-dichloroethene	Napthalene		None	None	None	None					
	cis-1,2-dichloroethene	Benzene		None	None	None	None					
	trans-1,2-dichloroethene	Tolune		None	None	None	None					
	1,1-dichloroethane	Ethylbenzene		None	None	None	None					
	1,2-dichloroethane	m/p-xylene		None	None	None	None					
	1,1,1-trichloroethane	o-xylene		None	None	None	None					
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None					
	1,1,2,2-tetrachloroethane			None	None	None	None					
	Vinyl Chloride			None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
Comme	ents:											
			-									
A 44 = -1- :												
Attachme	mis.											

0770

General Site Assessment Data

Нус	drogeologic Conceptu	al Model				Facility ID#:	0770				
<u>x</u>	Geology:	<u>Zone</u>	Unconsolidated S	Sediments_							
		Vadose Zone:	Relatively h	omogeneous and permeable	e unconsolidated se	diments					
			Relatively h	omogeneous and impermea	ble unconsolidated	sediments					
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			\underline{x} Largely impermeable sediments with inter-bedded layers of higher permeability material								
			Competent, but fractured bedrock (i.e. crystalline rock)								
			Weathered bedrock, limestone, sandstone								
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments								
			Relatively homogeneous and impermeable unconsolidated sediments								
			Largely permeable sediments with inter-bedded lenses of lower permeability material								
			x Largely imp	ermeable sediments with int	er-bedded layers of	higher permeability ma	terial				
			Competent,	but fractured bedrock (i.e. c	rystalline rock)						
			Weathered	bedrock, limestone, sandsto	ne						
<u>x</u>	Aquifer Characteris		No	Yes (number):	ft amsl <u>x</u> Uı	Unknow					
	is more man i aqu	ilei pieseiti:	Aguifer 1	Aquifer 2	Aquifer 3	ikilowii (assume single ac	luiiei)				
	Depth to water:	low value (ft bgs):	27	Aquiloi 2	Aquilor						
	Dopur to water.	high value (ft bgs):	30			-					
		Unknown:	<u>50</u>			-					
		Onknown.				-					
<u>x</u>	Flow direction		NE								
_						_					
<u>x</u>	Horizontal hydrauli	c gradient (feet/foot):	0.008			Unknow	n				
_	Vertical hydraulic g	-				Unknow	n				
<u>x</u>	K range (ft/day)	Measure	d using:	Slug Test Labor	atory	Field data					
		low	<u>13</u>			Unknow	n				
		high	<u>132</u>			_					

Comments:

Transmissivity (ft2/day):

Other - Terrace aluvium aquifer K=0.05 ft/day to 4.51ft/day

0.087

0.88

Measured using:

low high

Horizontal hydraulic gradient - 0.004

____ Unknown

____ Slug Test ____ Laboratory ____ Field data

The	rmal Treatment - Design								Faci	lity ID#:	<u>0770</u>	
<u>x</u>	Thermal treatment:		_ Conductive	е								
		<u>x</u>	Electrical l	Resistance								_
				_ 3 phase	<u>x</u>	6 phase	_	_ AC power		DC	power	
			_ Steam	-								-
				_ Steam		_ Steam + air	_	_ Steam + O	2			
v	Type of Test: x	Dilo	_ Other (deset test		caela Sustan							_
<u>X</u>	Type of Test: <u>x</u> Geology of Treatment Zone				-scale System	ous and permeal	hle un	consolidate	d sadi	iments		
<u>x</u>	Geology of Treatment Zonk	٥.	-		-	ous and imperme						
				_ ′	Ü	ediments with inte					bility materia	al
			<u>x</u>			sediments with i					-	
						ured bedrock (i.e						
				_ Weathere	ed bedrock,	limestone, sands	stone					
<u>x</u>	Treatment Targe Zone:		_ Saturated	l only	Vado	ose only	<u>x</u>	Both (Satur	rated a	nd Vadose	zones)	
<u>x</u>	Start of Thermal Test:	8/7/2	2000			Duration:	<u>88d</u>					
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No								
<u>x</u>	Treatment Cell Design:											
_	Size of target zone (ft2):				3120			Unkı	nown	(<u>4</u>	<u>5</u> x <u>45</u>	5 ft)
	Thickness of target zone (f	t):			<u>37</u>			Unkı	nown			
	Depth to top of target zone	(ft bo	gs):		2.5			Unkı	nown			
	Thickness of target zone be	elow	water table	(ft):	<u>7</u>			Unkı	nown			
	Number of energy delivery	point	s:		<u>7</u>			Unkı	nown			
	Number of extraction points	s:			<u>15</u>			Unkı	nown			
<u>x</u>	Temperature Profile:											
_	Initial formation temperatur	e (de	g C):			<u>22</u>				Unknown		
	Maximum representative for	ormati	ion tempera	iture (deg C	;):	<u>110</u>				Unknown		
	Time to reach maximum re	prese	entative tem	perature (d	ays):	<u>40</u>				_ Unknown		
	Duration of treatment at rep	orese	ntative temp	perature (da	ays):	<u>20</u>				Unknown		
						<u>Dat</u>	<u>e</u>		I	emperatur	e (deg C)	
	Formation temperature imp	nedia	tely post-tre	eatment:								
	Formation temperature pos	st-trea	atment moni	itoring even	it 1:							
	Duration of post-treatment	monit	toring (days	s):								
<u>x</u>	Mass of contaminant remo	ved:										
	Via I	liquid	pumping:		2.45	<u>i</u>		_ lb	<u>x</u>	kg	Unk	cnow
	In va	apor s	stream:		<u>150</u>			_ lb	<u>x</u>	kg	Unk	cnow
	Tota	ıl:			<u>150</u>			_ lb	<u>x</u>	kg	Unk	cnow
	Comments:											
	Volume t	reate	ed - 3930 c	ubic vds								
	Attachments:	· care	00000									

Cos	t and F	Performance						Facility ID#:	<u>0770</u>	
<u>x</u>	Perf	ormance								
_	Rem	ediation Go	al:							
			x In Groundwa	ter:						
			_			TCE less that	an 10 mg/L			
			x In Soil:							
			_			TCE less than 1	1.5 mg/kg			
	Was	the Remedi	ation Goal Achieve	d.						
	wao		x In Groundwa							
			Comme							
			Comme		s, except for WJETA062	ot 10.7 mg/l				
			x In Soil	163	s, except for WSL TAGGE	. at 10.7 mg/L				
			_							
			Comme							
				Yes	i					
	Gene	eral commer	nts on the thermal a	applicati	on:					
		Objective:	Reach the boiling p	ooint of	TCE at depth					
	Less	ons Learne	i							
_	_ Ener									
	Tota	I Energy Use				kWhr	kWhr/m ³	k\		
			Total energy applied	ed to tre	atment zone:			_ kWhr/m ³		kWhr/yd ³
			Other energy:					_ kWhr/m ³		kWhr/yd ³
			P	lease no	ote other energy:	-				
<u>x</u>	Cost									
	Tota	l Project Cos			<u>548306</u>					
			Consultant Cost:							
			Thermal Vendor C	ost:						
		<u>x</u>	Energy Cost:		<u>28588</u>	m ³		_ yd³		
		X	Other Cost 1:		<u>286718</u>					
		<u>x</u>	Other Cost 2:		<u>188515</u>					
		<u>x</u>	Other Cost 3:		44485					
	<u>x</u>	Please not	e other cost:	<u>x</u>	Other Cost 1:		capital	cost		
				<u>x</u>	Other Cost 2:	<u>op</u> e		naintenance		

x Other Cost 3:

other technology specific cost

File Analyzed By: PD ____ Date: 4/7/2005 Type of treatment: Conductive _Steam ERH ____Other: <u>X</u> Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Pesticides _Wood Treating Other: Treatment Status: ___ Active Post X Type of Test: ___ Pilot Test Full Scale System Start of Test: 5/13/2002 End of Test: 2/19/2002 Duration: 221 d Type of Site: DoD Non-DOD <u>X</u> Facility Name: Air Force Plant 4 Address: City, State, Zip Code: Ft. Worth, TX OU# or Site #: Building 181 Primary point of contact: George Walters Organization: Air Force Address: ASC/ENVR 1801 Tenth St., suite 2 City, State, Zip Code: Wright-Patterson AFB OH 45433-7626 Phone #: 937-255-1988 email: george.walters@wpafb.af.mil Other contacts or vendors who worked on site _None Point of contact: Craig Holloway Type: Vendor, Consultant __ Vendor, Technical Applications _ Other Organization: <u>URS</u> Address: 9400 Amberglen Boulevard City, State, Zip Code: Austin, TX 78729 Phone #: <u>512-454-4797</u> email: craig_holloway@urscorp.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data __Good pre- and post-treatment soil data ____ Good temperature profile vs. time information _ Flux assessment ___ Groundwater elevations _Geologic cross-section

Facility ID#:

0780

General Site Information

___ Hydraulic Conductivity information

<u>x</u> Impacte	d Zone:	Length (parallel to flow	v direction)(ft.): 1250 us defined by documentation	Width (ft):	<u>700</u> Thic	kness (ft): <u>30</u>		Unknown			
		Alternative methods	od for determining size of im	pacted zone (See source	zone definition attachme	ents)					
<u>x</u> Monito	Wells:	Number of relevant m	nonitoring wells with grounds	vater data: Pre-treatmer	nt: 12	Post-treatment:	<u>12</u>	None			
		Number of wells relat	ive to treatment zone:		_		_				
		Pre-treatment	In: 9	Upgradient:	Downgradient:	3 Cro	ossgradient:				
		Post-treatment	In: <u>9</u>	Upgradient:	Downgradient:	_	ossgradient:				
			=			=					
<u>x</u> Soil Borings: Number of relevant soil borings with pre-treatment data: <u>10</u>											
		Number of relevant so	il borings with post-treatmen	it data: 1	<u>10</u>						
		Number inside treatme	ent zone: 10	Number outs	ide treatment zone:	<u>10</u>					
x Types o	f Contamina	nts		T							
						nent Concentration per emical:		nent Concentration per mical:			
	Cł	lorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
	x Tric	hloroethene	Hexane	Creosote	10 mg/L	1 mg/kg	5 mg/L	0.1 mg/kg			
	Tetr	achloroethene	Jet Fuel		None	None	None	None			
	1,1-	dichloroethene	Napthalene		None	None	None	None			
	cis-	1,2-dichloroethene	Benzene		None	None	None	None			
	tran	s-1,2-dichloroethene	Tolune		None	None	None	None			
	1,1-	dichloroethane	Ethylbenzene		None	None	None	None			
	1,2-	dichloroethane	m/p-xylene		None	None	None	None			
	1,1,	1-trichloroethane	o-xylene		None	None	None	None			
Chemicals of Concern	1,1,	2-trichloroethane			None	None	None	None			
	1,1,	2,2-tetrachloroethane			None	None	None	None			
	Vin	yl Chloride			None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
Comn	nents:										
	_										
						<u>—</u>					
Attachm	ents:										
	_										

0780

General Site Assessment Data

Hyd	rogeologic Conceptua	ıl Model		Facility ID#:	0780					
<u>x</u>	Geology:	<u>Zone</u>	<u>Unconsolidated Sediments</u>							
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated s	sediments						
			Relatively homogeneous and impermeable unconsolidated sediments							
			Largely permeable sediments with inter-bedded lenses of lower permeability material							
			x Largely impermeable sediments with inter-bedded layers	of higher permeability mater	rial					
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments							
			Relatively homogeneous and impermeable unconsolidate	d sediments						
			Largely permeable sediments with inter-bedded lenses of	lower permeability material						
			x Largely impermeable sediments with inter-bedded layers	of higher permeability mater	rial					
			Competent, but fractured bedrock (i.e. crystalline rock)							
			Weathered bedrock, limestone, sandstone							
<u>x</u>	Ground surface elev	ration based on wells in	or adjacent to treatment zone: 650 ft amsl	Unknown						
<u>x</u>	Aquifer Characteristi	ics:								
	Is more than 1 aquife	er present?	No <u>x</u> Yes (number): <u>2</u>	Unknown (assume single aquit	fer)					
			Aquifer 1 Aquifer 2 Aquifer 3							
	Depth to water:	low value (ft bgs):	<u></u>	_						
		high value (ft bgs):	<u>30</u>	_						
		Unknown:		_						

<u>x</u>	Horizontal hydraulic gradient (feet/fo	•	0.008					 	Unknown Unknown
<u>x</u>	K range (ft/day)	Measured	using:	Slug	Test	Laborat	ory	Field da	ta
		low	<u>13</u>						Unknown
		high	<u>132</u>					_	
	Transmissivity (ft2/day):	Measured	using:	Slug	Test	Laborat	ory	Field da	ta
		low	0.087						Unknown
		high	0.88					_	

NE

Comments:

Flow direction

Other - Terrace aluvium aquifer K=0.05 ft/day to 4.51ft/day

Horizontal hydraulic gradient - 0.004

The	rmal Treatment - Design								Facility ID#:	<u>0780</u>
<u>x</u>	Thermal treatment:		_ Conducti	ive						
		<u>x</u>	Electrica	l Resistance						
			<u>x</u> _ Steam	3 phase	<u>x</u>	6 phase		AC power	D	C power
			_ Steam	Steam		Steam + air		Steam + O2		
			Other (de	escribe)						
<u>x</u>	Type of Test:	_ Pilot	test	<u>x</u> Full-	-scale Syste	em				
<u>x</u>	Geology of Treatment Zone	э:		Relatively	homogen	eous and pern	neable und	consolidated	sediments	
				Relatively	/ homogen	eous and impe	ermeable ι	unconsolidat	ed sediments	
				Largely p	ermeable :	sediments with	n inter-bed	ded lenses o	of lower perme	eability material
			<u>x</u>	Largely in	npermeabl	e sediments w	ith inter-be	edded layers	s of higher per	rmeability material
				Competer	nt, but frac	tured bedrock	(i.e. crysta	alline rock)		
				Weathere	ed bedrock	, limestone, sa	andstone			
<u>x</u>	Treatment Targe Zone:		_ Saturate		Va		<u>x</u>	Both (Satura	ated and Vados	e zones)
<u>x</u>	Start of Thermal Test:	5/13	/2002			Durat	ion: 221 d	<u>1</u>		
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				21780			Unkn	own (<u>´</u>	130 x 150 ft)
	Thickness of target zone (f	t):			<u>37</u>			Unkn	own	
	Depth to top of target zone	(ft bg	js):		<u>0</u>			Unkn	own	
	Thickness of target zone be	elow v	water table	e (ft):	<u>5</u>			Unkn	own	
	Number of energy delivery	points	s:		<u>73</u>			Unkn	own	
	Number of extraction points	S:			<u>10</u>			Unkn	own	
<u>x</u>	Temperature Profile:									
_	Initial formation temperatur	e (de	g C):			23.4			Unknow	'n
	Maximum representative for			rature (deg C	;):	90			Unknow	'n
	Time to reach maximum re	prese	entative te	mperature (d	ays):	<u>100</u>			Unknow	'n
	Duration of treatment at rep	-				<u>121</u>			Unknow	'n
	Compation to an austrus ince	مائم م	4.01 4				<u>Date</u>		<u>I emperat</u>	ure (deg C)
	Formation temperature imp				.+ 1.					
	Formation temperature pos Duration of post-treatment			•	н.					
	Duration of post-treatment	monic	ioning (da)	(3).						
<u>x</u>	Mass of contaminant remove	ved:								
	Via I	iquid	pumping:		0.2	<u>27</u>		lb	<u>x</u> kg	Unknow
	In va	apor s	stream:		640	<u>).9</u>		_lb	<u>x</u> kg	Unknow
	Tota	ıl:			641	.15		lb	<u>x</u> kg	Unknow
	Comments:									
	Attachments:									

Cos	st and Performa	nce					Facility ID#:	<u>0780</u>
<u>x</u>	Performance							
_	Remediation	Goal:						
		<u>x</u>	In Groundwa	ter:				
		_				TCE less than	10 mg/L	
		<u>x</u>	In Soil:				_ _	
		_				TCE less than 11.5	mg/kg	
	Was the Ren	nediatio	n Goal Achieve	q.				
		X	In Groundwa					
		Δ	Comme					
					, except for WJETA062	e at 10.7 mg/l		
		<u>x</u>	In Soil	100	, OXOOPT FOI TYOU I THOU	<u>. at 10.7 mg/L</u>		
		Δ	Comme	nt.				
			Comme	Yes				
				100				
	General com	ments o	on the thermal a	pplicati	on:			
	Target	temper	ature - Boiling p	oint of 1	CE at depth			
	Lessons Lea Area ne	ear tank	did not allow e	lectrode	s, and thus area is still	above target goal and co	entinues to rise in ground	water, as of
	10/200	6 well w	as at 37,000 pr	b.				
<u>x</u>	Energy							
^	Total Energy	Head:	11	399000		x kWhr k	kWhr/m³ kV	/br/vd ³
			al energy applie		otmont zono:	x kWhrk	kWhr/m ³	kWhr/yd ³
			ar energy applic ner energy:	eu to tre			kWhr/m ³	
	_	01	٠.	ı			KVVIII/III	KVVIII/yd
			P	ease no	ote other energy:			
<u>x</u>	Cost							
_	Total Project	Cost:			2369633			
	, , , , , , , , , , , , , , , , , , , ,		nsultant Cost:					
	_		ermal Vendor C	nst·				
			ergy Cost:		<u>85455</u>	m ³	yd³	
	<u>x</u>						yu	
	<u>X</u>		ner Cost 1:		740294 1505648			
	<u>x</u>		ner Cost 2:		<u>1505648</u>			
	X		ner Cost 3:		<u>38236</u>		9-1	
	<u>x</u> Please	note ot	her cost:	<u>x</u>	Other Cost 1:		capital cost	
				Х	Other Cost 2:	operation and	I maintenance for techno	loav

x Other Cost 3:

other technology specific cost

<u>x</u>	File Analyzed By: JT	<u>x</u> PD	_					Date:	10/19/2006
	Type of treatment:	Conductiv	re	Steam	ERH	<u>x</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	Chlorinate	ed Solvents	<u>x</u>	Petroleum Hyd	drocarbo	ns	Pesticides	
		Wood Tre	ating		Other:				
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	<u>x</u> Pilot Test		Full Scal	e System				
	Start of Test:	4/3/1993		End	of Test: <u>6/3/1993</u>	<u> </u>		Duration: 61 d	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: Kelly AFE	<u>s (IITRI)</u>							
	Address:								_
	City, State, Zip Code:	San Antonio, TX	<u> </u>						
	OU# or Site #: <u>S-1</u>								
	_ Primary point of contact:								
	Organization:								_
	Address:								
	City, State, Zip Code:								
	Phone #:			email:					_
	Other contacts or vendors wh	no worked on site			None				
	Point of contact:								
	Type:Vendor, C	onsultant	Vei	ndor, Techn	ical Applications		Oth	ner	
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:			email:					
Q.	A/QC								
	_Characteristics of Interest								
	Good pre- and post-tre	atment groundwat	er data		Good pre	e- and p	ost-treatme	nt soil data	
	Good temperature prof	ile vs. time inform	nation		Flux asse	essment			
	Groundwater elevation	is			Geologic	c cross-s	ection		
	Hydraulic Conductivity	y information							

0800

General Site Information

3	x Impacted 2			Width (ft):	Thick	ness (ft):		<u>x</u> Unknown				
			is defined by documentation									
				pacted zone (See source zo	ne definition attachmer	nts)						
		Map attachment										
2	x Monitor W	Vells: Number of relevant m	nonitoring wells with grounds					None				
				Pre-treatment:		Post-treatment:	<u>3</u>					
		Number of wells relati										
		Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:					
		Post-treatment	In: <u>3</u>	Upgradient:	Downgradient:	Cros	ssgradient:					
	x Soil Boring	gs: Number of relevant so	Number of relevant soil borings with pre-treatment data: 21									
		Number of relevant so	Number of relevant soil borings with post-treatment data: 21									
			Number inside treatment zone: $16/16$ Number outside treatment zone: $5/5$									
						·						
	x Types of C	Contaminants										
	_											
						ent Concentration per nical:		ent Concentration per nical:				
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
Ī		Trichloroethene	Hexane	Creosote	None	None	None	None				
	x Types of Contain	Tetrachloroethene	Jet Fuel		None	None	None	None				
l		1,1-dichloroethene	Napthalene		None	None	None	None				
l		cis-1,2-dichloroethene	x Benzene		None	None	None	None				
l		trans-1,2-dichloroethene	Tolune		None	None	None	None				
l		1,1-dichloroethane	Ethylbenzene		None	None	None	None				
l		1,2-dichloroethane	m/p-xylene		None	None	None	None				
l		1,1,1-trichloroethane	o-xylene		None	None	None	None				
l		1,1,2-trichloroethane	x chlorobenezene		None	5 mg/kg	None	5 mg/kg				
l		1,1,2,2-tetrachloroethane	x TRPH		None	None	None	None				
l		Vinyl Chloride			None	None	None	None				
l					None	None	None	None				
l					None	None	None	None				
l					None	None	None	None				
l					None	None	None	None				
l					None	None	None	None				
l					None	None	None	None				
			-	-								
	Commer	nts:										
					-							
	Attachmen	nts:										

0800

General Site Assessment Data

Hyd	rogeologic Conceptua	al Model		Facility ID#	: <u>0800</u>
<u>x</u>	Geology:	Zone	<u>Unconsolidated Sediments</u>		
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated se	ediments	
			Relatively homogeneous and impermeable unconsolidated	I sediments	
			\underline{x} Largely permeable sediments with inter-bedded lenses of I	ower permeabili	ty material
			Largely impermeable sediments with inter-bedded layers o	of higher permea	bility material
			Competent, but fractured bedrock (i.e. crystalline rock)		
			Weathered bedrock, limestone, sandstone		
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated se	ediments	
			Relatively homogeneous and impermeable unconsolidated	l sediments	
			\underline{x} Largely permeable sediments with inter-bedded lenses of I	ower permeabili	ty material
			Largely impermeable sediments with inter-bedded layers o	of higher permeal	bility material
			Competent, but fractured bedrock (i.e. crystalline rock)		
			Weathered bedrock, limestone, sandstone		
<u>x</u>	Ground surface ele	vation based on wel	s in or adjacent to treatment zone: 690 ft amsl		Unknown
<u>X</u>	Aquifer Characteris	tics:			
	Is more than 1 aqui	fer present?	No Yes (number): <u>x</u>	Jnknown (assume	single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3		
	Depth to water:	low value (ft bgs): <u>24</u>	_	
		high value (ft bg	s): <u>33</u>	_	
		Unknown:		_	
	_ Flow direction			_	
<u>X</u>	Horizontal hydraulic	-			Unknown
	Vertical hydraulic g	radient (feet/foot):		<u>X</u>	Unknown
<u>x</u>	K range (ft/day)		sured using: Slug Test Laboratory	Field data	** 1
		low	<u>15.5</u>		Unknown
	Towards shifty (fig.)	high	Obs. Test	- F: 11 1 .	
	Transmissivity (ft2/d	**	sured using: Slug Test Laboratory	Field data	
		low		<u>X</u>	Unknown
		high		_	
	_				
	Comments:				

The	rmal Treatment - Design							Facility ID)#: <u>0</u>	800
<u>x</u>	Thermal treatment:	Conductive	·							
	_	Electrical R	Resistance							
			3 phase		6 phase	_	AC power		_DC pov	/er
		Steam								
			Steam		Steam + a	air	Steam +	O2		
	<u>x</u>	Other (desc			(IITRI)					
<u>x</u>	·· —	ot test	Full-		-					
<u>x</u>	Geology of Treatment Zone:				geneous and p					
			-		geneous and ir	-				
		<u>X</u>			ble sediments v			•		-
		· · · · · · · · · · · · · · · · · · ·			eable sediment		-	_	permeal	oility material
			-		fractured bedro			3)		
	Total and Tarres 7 and a	0-11			rock, limestone,			1 137	,	
<u>X</u>	<u> </u>	Saturated	only	<u>X</u>	Vadose only			turated and Va	idose zon	es)
<u>X</u>	_	3/199 <u>3</u>			Du	ration: 61	<u>d</u>			
	_ Hydraulic Control	Yes	No							
~	Treatment Cell Design:									
<u>X</u>	Size of target zone (ft2):			141			Un	known	(10	x 14 ft)
	Thickness of target zone (ft):			23.3			Un		(<u>10</u>	x <u>14</u> It)
	Depth to top of target zone (ft b	ue).		0			Un			
	Thickness of target zone below		ft)·	<u>0</u>				known		
	Number of energy delivery poir		11.).	<u>∪</u> 4				known		
	Number of extraction points:	113.		<u> 16</u>				known		
	realison of extraorion points.			10				ikilowii		
<u>x</u>	Temperature Profile:									
_	Initial formation temperature (d	eg C):			<u>20</u>			Unk	nown	
	Maximum representative forma	tion temperat	ture (deg C	;):	<u>110</u>			Unk	nown	
	Time to reach maximum repres	sentative temp	perature (da	ays):	<u>56</u>			Unk	nown	
	Duration of treatment at repres	entative temp	erature (da	ays):	<u>4</u>			Unk	nown	
						<u>Date</u>		Tempe	erature (d	leg C)
	Formation temperature immedi	ately post-trea	atment:							
	Formation temperature post-tre	eatment monit	oring even	t 1:						
	Duration of post-treatment mor	nitoring (days)	:							
<u>x</u>	Mass of contaminant removed:									
	Via liqui	d pumping:					lb	kg	<u>x</u>	Unknow
	In vapor	stream:	-				lb	kg	<u>x</u>	Unknow
	Total:						lb	kg	<u>x</u>	Unknow
	Comments:									
	Attachments:									

Cos	t and Performance					Facility ID#:	<u>0800</u>
	_ Performance						
	Remediation Goal:						
		In Groundwater: -					
		In Soil:					
	Was the Remediation	n Goal Achieved:					
	_	_ In Groundwater _					
		Comment: -					
		_					
		_ In Soil _					
		Comment: -					
		_					
	General comments	on the thermal applica	ation:				
		on the thermal applied					
	Lessons Learned						
	_ Energy						
	Total Energy Used:			kWhr			Whr/yd ³
	Tot	al energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd³
	Oth	ner energy:				_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
	_						
X	Cost						
	Total Project Cost:		<u>2536093</u>				
	· 	nsultant Cost:					
		ermal Vendor Cost:					
	End	ergy Cost:			m ³	_ yd³	
	Oth	ner Cost 1:					
	Oth	ner Cost 2:					
	Oth	ner Cost 3:					
	Please note of	her cost:	Other Cost 1:				
			Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/19/2006
	Type of treatment:	Conductive		_Steam	ERH	<u>x</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	Chlorinated Solv	ents	<u>x</u>	Petroleum Hyd	rocarbo	ons	Pesticides	
	•	Wood Treating			Other:			· 	
	Treatment Status:	Active	<u>x</u>	Post	_				
	Type of Test:	x Pilot Test		Full Scale	System				
	Start of Test:	4/26/1994		End	of Test: 6/14/1994	<u>4</u>		Duration: 50 d	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: Kelly AFB Address:	(KAI)							_
	City, State, Zip Code:	San Antonio, TX							
	OU# or Site #: <u>S-1</u>								
	_ Primary point of contact:								_
	Organization:								_
	Address:								
	City, State, Zip Code:								_
	Phone #:			email:					_
	Other contacts or vendors who	o worked on site			None				
	Point of contact:								
	Type: Vendor, Co	nsultant	_Ven	dor, Techni	cal Applications		Oth	er	
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:			email:					
Q	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-trea	tment groundwater data			Good pre	- and p	ost-treatme	nt soil data	
	Good temperature profil	le vs. time information			Flux asse	ssment			
	Groundwater elevations	3			Geologic	cross-s	ection		

0801

General Site Information

____ Hydraulic Conductivity information

<u>x</u>	Impacted 2	3 "		Width (ft):	Thick	ness (ft):		<u>x</u> Unk	nown		
		Impacted zone a	as defined by documentation								
		Alternative meth	od for determining size of im	pacted zone (See source zo	ne definition attachmer	nts)					
		Map attachment									
<u>x</u>	Monitor W	Vells: Number of relevant m	nonitoring wells with groundy	vater data:				None			
				Pre-treatment:		Post-treatment:					
		Number of wells relat	ive to treatment zone:								
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:				
		Post-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:				
<u>x</u>	Soil Boring	gs: Number of relevant so	Number of relevant soil borings with pre-treatment data: 24								
		Number of relevant so	il borings with post-treatmen	nt data: <u>24</u>							
		Number inside treatme	ent zone: <u>22 / 22</u>	Number outside	treatment zone:	2/2					
<u>x</u>	Types of C	Contaminants									
					A Post document	C	A Bart tour				
					Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Cher	ent Concent nical:	ration per		
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)		
		Trichloroethene	Hexane	Creosote	None	None	None	None			
		Tetrachloroethene	Jet Fuel		None	None	None	None			
		1,1-dichloroethene	Napthalene		None	None	None	None			
		cis-1,2-dichloroethene	x Benzene		None	None	None	None			
		trans-1,2-dichloroethene	Tolune		None	None	None	None			
		1,1-dichloroethane	Ethylbenzene		None	None	None	None			
		1,2-dichloroethane	m/p-xylene		None	None	None	None			
		1,1,1-trichloroethane	o-xylene		None	None	None	None			
(Chemicals of Concern	1,1,2-trichloroethane	x chlorobenezene		None	None	None	None			
	001100111	1,1,2,2-tetrachloroethane	x TRPH		None	1 mg/kg	None	1 mg/k	cg		
		Vinyl Chloride			None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
					None	None	None	None			
_			7.5.10								
	Comme	nts:									
	Attachmen	nts:									
		-									
		-									

0801

General Site Assessment Data

Hyd	rogeologic Conceptu	al Model					Facility ID#	#: <u>0801</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relative Relative X Largely Largely Compete Weather Relative Relative X Largely Largely Compete	ly homogeneous permeable serimpermeable serimpermea	us and impermeal diments with inter- sediments with inter- sed bedrock (i.e. co mestone, sandstor us and permeable us and impermeal diments with inter-	ne unconsolidated septemble unconsolidated bedded lenses of lender-bedded layers of rystalline rock)	sediments ower permeabil f higher permea ediments sediments ower permeabil	ability material
<u>x</u>	Ground surface ele	evation based on wells in c	or adjacent to tre	eatment zone:	<u>690</u>	ft amsl		Unknown
<u>x</u>	Aquifer Characteris	stics:						
	Is more than 1 aqui	ifer present?	No	Yes (num	ber):	<u>x</u> U	Jnknown (assume	e single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 24 33		Aquifer 2	Aquifer 3	-	
	_							
X	Horizontal hydraulic g	c gradient (feet/foot): radient (feet/foot):					_ <u>x</u>	Unknown Unknown
<u>x</u>	K range (ft/day)	Measured low high	using:	Slug Test	Labora	atory _	Field data	_ Unknown
	Transmissivity (ft2/	day): Measured low high	using:	Slug Test	Labor	atory _	Field data <u>X</u>	Unknown
	Comments:							

The	rmal Treatment - Design					Facility ID#:	080	<u>1</u>
<u>x</u>	Thermal treatment:	Conductive						
		Electrical Resis	tance					
		3 p	hase	6 phase	AC pov	/er1	DC power	r
		Steam						
		Ste	am	Steam + ai	r Steam -	- O2		
		x Other (describe) <u>RF</u>	H (KAI)				
<u>x</u>	Type of Test:	Pilot test	Full-scale	System				
<u>x</u>	Geology of Treatment Zor	ne: Re	latively hon	nogeneous and pe	rmeable unconsolid	ated sediments		
		Re	latively hon	nogeneous and im	permeable unconso	lidated sediment	ts	
		<u>x</u> La	rgely perme	able sediments wi	th inter-bedded lens	es of lower pern	neability	material
		La	rgely imperi	meable sediments	with inter-bedded la	yers of higher p	ermeabili	ity material
		Co	mpetent, bu	ut fractured bedroo	k (i.e. crystalline roc	:k)		
		We	eathered be	drock, limestone, s	sandstone			
<u>x</u>	Treatment Targe Zone:	Saturated only	/ <u>x</u>	Vadose only	Both (S	aturated and Vado	ose zones))
<u>x</u>	Start of Thermal Test:	4/26/1994		Dura	ation: <u>50 d</u>			
<u>15</u>	0 Hydraulic Control	Yes	No					
10	0 Treatment Cell Design:							
	Size of target zone (ft2):		141	ı	T	nknown (10 x	<u>15</u> ft)
	Thickness of target zone	(ft)·	23.		· <u></u>	nknown	<u></u>	<u></u> 10)
	Depth to top of target zon		0	<u>~</u>	· <u></u>	nknown		
	Thickness of target zone I		0			nknown		
	Number of energy deliver	, ,	4			nknown		
	Number of extraction poin	•	<u>.</u> 16		· <u></u>	nknown		
-	4 Temperature Profile:							
	Initial formation temperatu	ıre (deg C):				Unkno	wn	
	Maximum representative	formation temperature	(deg C):			Unkno	wn	
	Time to reach maximum r	epresentative tempera	iture (days):			Unkno	wn	
	Duration of treatment at re	epresentative tempera	ture (days):			Unkno	wn	
					<u>Date</u>	Tempera	ature (de	g C)
	Formation temperature im	mediately post-treatm	ent:					
	Formation temperature po	st-treatment monitorin	ig event 1:	-				
	Duration of post-treatmen	t monitoring (days):						
(0 Mass of contaminant rem	oved:						
	_	liquid pumping:			lb	kg	<u>x</u>	Unknow
		vapor stream:			lb	kg	<u>_</u>	Unknow
	Tot				lb	kg	<u>x</u>	Unknow
	Comments:							
	<u>2</u>							
	Attachments:							

Cost and Performance				Facility ID#:	<u>0801</u>
Performance					
Remediation Goal:					
In Groundwate	er:				
In Soil:					
<u> </u>					
Was the Remediation Goal Achieved:	:				
In Groundwate					
Commen	nt:				
In Soil					
Commen	t:				
General comments on the thermal ap	plication:				
Lessons Learned					
Energy					
Total Energy Used:		kWhr	kWhr/m ³	kW	/hr/vd ³
Total energy applied	to treatment zone:			_ kWhr/m ³	kWhr/yd ³
Other energy:				_ kWhr/m ³	kWhr/yd ³
	ase note other energy:				,,
1.10	aco note callor energy.				
<u>x</u> Cost					
Total Project Cost:	<u>2477216</u>				
Consultant Cost:					
Thermal Vendor Cos	st:				
Energy Cost:			m ³	_ yd³	
Other Cost 1:					
Other Cost 2:					
Other Cost 3:					
Please note other cost:	Other Cost 1:				
	Other Cost 2:				

Other Cost 3:

File Analyzed By: PD ____ Date: 9/27/2006 Type of treatment: Conductive ____ Steam <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents X Petroleum Hydrocarbons Other: Wood Treating Treatment Status: Active Post Type of Test: Pilot Test ___ Full Scale System Start of Test: 1998 End of Test: 2003 Duration: varied Type of Site: __ DoD Non-DOD Facility Name: Petro-Chemical System (AKA Turtle Bayou) Address: City, State, Zip Code: Liberty, TX OU# or Site #: Primary point of contact: Chris Villarreal Organization: Address: City, State, Zip Code: Phone #: 214-665-6758 email: chris.villarrreal@epamail.epa.gov Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC Characteristics of Interest ___ Good pre- and post-treatment groundwater data _ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information Flux assessment ___ Groundwater elevations Geologic cross-section

Facility ID#:

0810

General Site Information

___ Hydraulic Conductivity information

General Site Assessment Data Facility I										0810	
2	x Impacted	Zone:		w direction)(ft.):		Thickr	ness (ft):		<u>x</u>	Unknown	
				as defined by documentation							
				=	npacted zone (See source zo	one definition attachment	ts)				
			Map attachment	I							
2	x Monitor V	Vells:	Number of relevant r	monitoring wells with ground			_		<u>x</u> 1	None	
					Pre-treatment:		Post-treatment:				
				tive to treatment zone:							
			Pre-treatment	In:	Upgradient:	Downgradient: _		ssgradient:			
			Post-treatment	In:	Upgradient:	Downgradient: _	Cros	ssgradient:			
2	x Soil Boring	gs:		oil borings with pre-treatment		1, 2					
				oil borings with post-treatmer							
			Number inside treatm	ent zone: 1, 2, 1, 1, 2	Number outside	e treatment zone:					
2	x Types of C	Contamina	nts		1	1					
									Chemical:		
		Cł	nlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	5	Soil (mg/kg)	
		Tric	hloroethene	Hexane	Creosote	None	None	None	1	None	
	Tetr	achloroethene	Jet Fuel		None	None	None	1	None		
		<u>x</u> 1,1-	dichloroethene	Napthalene		Other Groundwater (mg/L) Soil (mg/kg) Groundwater (mg/L) Soil (mg/kg) Creosote None None None None None None None None None	None				
		cis-	1,2-dichloroethene	<u>x</u> Benzene	Chemical: Chemical: Chemical:	None					
	_	tran	s-1,2-dichloroethene	x Tolune		None	None	None	I	None	
		<u>x</u> 1,1-	dichloroethane	Ethylbenzene		None	None	None	I	None	
		<u>x</u> 1,2-	dichloroethane	m/p-xylene		None	None	None	I	None	
		1,1,	1-trichloroethane	o-xylene		None	None	None	J	None	
	Chemicals of Concern	1,1,	2-trichloroethane	x naphthalene		None	None	None	J	None	
		1,1,	2,2-tetrachloroethane	x xylenes		None	None	None	J	None	
		x Vin	yl Chloride			None	None	None		None	
		x 12-I	DCE_			None	None	None		None	
				x Ethylbenzene		None	None	None		None	
				x TBA		None	None	None		None	
				x Acetone		None	None	None	,	None	
						None	None	None		None	
						None	None	None		None	
			·								
	Comme	Comments:									
					# of borings per cell	for exampl: 1, 2, 3, a	ind 4				
		_									
	Attachmer	nts:									
		_									
		_									

Hyd	rogeologic Conceptua	al Model					Facility ID#:	0810
X	Geology:	Zone Vadose Zone: Saturated Zone:		diments sediments wer permeability materia higher permeability mate diments sediments wer permeability materia higher permeability materia	erial			
<u>x</u>	Ground surface ele	vation based on wells in	or adjac	ent to trea	atment zone:	ft amsl	Unknown	
X	Aquifer Characteris Is more than 1 aqui Depth to water:		_ No	<u>x</u> quifer 1	Yes (number):Aquifer 2	Ui Aquifer 3	aknown (assume single aqu - -	ifer)
x	Flow direction		S to SV	<u>V</u>				
 <u>X</u> Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): 							Unknown	

____ Slug Test

____ Slug Test

T (ft2/day)

____ Laboratory

____ Laboratory

K range (ft/day)

Comments:

Attachments:

Transmissivity (ft2/day):

unit

0.0036

0.09

Measured using:

Measured using:

below

below

low

high

low

high

K(ft/day)

____ Field data

____ Field data

____ Unknown

____ Unknown

M1

The	rmal Treatment - Design											Fac	ility ID#:	081	0
<u>x</u>	Thermal treatment:		_ Condu	ctive											
		<u>x</u>	Electri	cal Res	sistance	Mai	n Waste area								
			-	3	phase		6 pha	ise		AC po	ower		E	C powe	r
		_	_ Steam	-											
			-	S	team		Stear	n + air		Steam	1 + O2	2			
			_ Other												
<u>x</u>	Type of Test: <u>x</u>	Pilot			Full		•								
<u>x</u>	Geology of Treatment Zone	e:	-		-		ogeneous ar	-							
					-		ogeneous ar	•							
			-				able sedimer						-	-	
			-				neable sedim					s of h	nigher pe	rmeabil	ity material
			-				t fractured b			illine r	ock)				
	To also and Town 7.00		0-1				drock, limest			D .1 .	(G.)		137 1		
<u>X</u>	Treatment Targe Zone:			ated or	nıy		_ Vadose onl	-	<u>X</u>		(Satur	ated a	and Vado	se zones)
<u>X</u>	Start of Thermal Test:	Dec-			NT.			Duration:	27 m	onths					
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	-	No										
<u>x</u>	Treatment Cell Design:														
-	Size of target zone (ft2):										Unkn	own	(x	ft)
	Thickness of target zone (fi	t):				22		,			Unkn		_		
	Depth to top of target zone		ıs):			2									
	Thickness of target zone be			ble (ft)	:	12									
	Number of energy delivery			()		8									
	Number of extraction points	s:				<u>29</u>				_	Unkn	own			
<u>x</u>	Temperature Profile:														
_	Initial formation temperatur	e (dec	g C):									<u>x</u>	Unknov	vn	
	Maximum representative for		-	eratur	e (deg C	:):						x	Unknov		
	Time to reach maximum re	prese	ntative	tempe	rature (d	ays):						<u>x</u>	Unknov	vn	
	Duration of treatment at rep	oreser	ntative t	emper	ature (da	ays):						<u>x</u>	Unknov	vn	
								Date	<u>:e</u>			1	<u> Tempera</u>	ture (de	<u>g C)</u>
	Formation temperature imm	nediat	tely pos	t-treat	ment:										
	Formation temperature pos	st-trea	tment n	nonitor	ing even	it 1:									
	Duration of post-treatment	monit	oring (d	lays):											
<u>x</u>	Mass of contaminant remove	ved:													
	Via I	liquid	pumpin	g:						lb		_	_ kg	<u>x</u>	Unknown
	In va	apor s	tream:							lb			_ kg	<u>x</u>	Unknown
	Tota	al:								lb			_ kg	<u>x</u>	Unknown
	Comments:														
										_					
	Attachments:														
															-

The	rmal Treatment - Design								Facil	ity ID#:	0810	<u>)</u>
<u>x</u>	Thermal treatment:		Conductive									
		<u>x</u> E	Electrical Resista	ance W	Vest waste area							
			3 ph	ase	6 pha	ise		AC power		DC	power	
		S	team									
			Stea	m	Steam	n + air		Steam + O2	2			
			Other (describe)	_								
<u>x</u>	Type of Test: <u>x</u>	Pilot te			le System							
<u>x</u>	Geology of Treatment Zone	e:		-	mogeneous ar	•						
				-	mogeneous ar	•						
					neable sedimer						•	
					rmeable sedim			-	s of h	igher perr	neabili	ty material
			<u> </u>	-	but fractured be		-	Illine rock)				
		_			edrock, limesto							
<u>X</u>	Treatment Targe Zone:		Saturated only	_	Vadose onl	•		Both (Satur	ated a	nd Vadose	zones)	
<u>X</u>	Start of Thermal Test:	Oct-98	,	3.7		Duration:	43 mc	onths .				
<u>x</u>	Hydraulic Control	<u>x</u> Y	es	_ No								
<u>x</u>	Treatment Cell Design:											
	Size of target zone (ft2):			_				Unkn	own	(_ x	ft)
	Thickness of target zone (f	t):		2	8			Unkn	own			
	Depth to top of target zone	(ft bgs):		0				Unkn	iown			
	Thickness of target zone be	elow wa	ter table (ft):	10	<u>6</u>			Unkn	iown			
	Number of energy delivery	points:		1	2			Unkn	iown			
	Number of extraction points	s:		10	6			Unkn	own			
<u>x</u>	Temperature Profile:											
	Initial formation temperatur	e (deg C	C):						<u>x</u>	Unknown	1	
	Maximum representative for	ormation	temperature (deg C):					<u>x</u>	Unknown	1	
	Time to reach maximum re	presenta	ative temperat	ure (days	s):				<u>x</u>	Unknown	1	
	Duration of treatment at rep	presenta	tive temperatu	ıre (days):				<u>x</u>	Unknown	1	
						<u>Date</u>	<u>e</u>		<u>T</u>	<u>emperatu</u>	re (deg	<u>ı C)</u>
	Formation temperature imp	mediatel	y post-treatme	nt:								
	Formation temperature pos	st-treatm	ent monitoring	event 1:								
	Duration of post-treatment	monitori	ng (days):									
<u>x</u>	Mass of contaminant remo	ved:										
	Via I	liquid pu	mping:					lb		kg	<u>x</u>	Unknown
	In va	apor stre	am:					lb		kg	<u>x</u>	Unknown
	Tota	al:						lb		kg	<u>x</u>	Unknown
	Comments:											
	Attachments:											

Ther	rmal Treatment - Design					Facility ID:	#: <u>0810</u>	<u>)</u>
<u>x</u>	Thermal treatment:	Conductive						
		<u>x</u> Electrical Resistance	Office trailer	area				
		3 phase	6	phase	AC pow	er	DC power	
		Steam						
		Steam	S	Steam + air	Steam +	O2		
		Other (describe)						
<u>x</u>	Type of Test: \underline{x}	Pilot test Full-	-scale System					
<u>x</u>	Geology of Treatment Zone	e: Relatively	homogeneou	s and permeat	ole unconsolida	ited sediments	3	
		Relatively	homogeneou	s and imperme	eable unconsoli	dated sedime	nts	
		Largely pe	ermeable sedi	ments with inte	er-bedded lense	es of lower per	rmeability r	naterial
		<u>s</u> Largely in	npermeable se	ediments with i	nter-bedded lay	ers of higher	permeabilit	y material
		Competer			-	k)		
				nestone, sands	tone			
<u>X</u>	Treatment Targe Zone:	Saturated only	Vadose	-		turated and Va	dose zones)	
<u>X</u>	Start of Thermal Test:	Oct-98		Duration:	39 months			
<u>x</u>	Hydraulic Control	<u>x</u> Yes No						
v	Treatment Cell Decign:							
<u>x</u>	Treatment Cell Design: Size of target zone (ft2):				Ur	-l		ft)
	Thickness of target zone (ft	t)·	22		· <u></u>	nknown	x	11)
	Depth to top of target zone		2		Ur			
	Thickness of target zone be		= 12		Ur			
	Number of energy delivery		12		Ur			
	Number of extraction points		<u></u>		Ur			
	·							
<u>x</u>	Temperature Profile:							
	Initial formation temperature	e (deg C):	_			<u>x</u> Unkr	nown	
	Maximum representative fo	ormation temperature (deg C	:): _			<u>x</u> Unkr	nown	
	Time to reach maximum rep	presentative temperature (da	ays): _			<u>x</u> Unkr	nown	
	Duration of treatment at rep	presentative temperature (da	ays):			<u>x</u> Unkr	nown	
				Date	<u>e</u>	Tempe	rature (deg	<u>(C)</u>
	Formation temperature imm		=					
		st-treatment monitoring even	t 1: _					
	Duration of post-treatment	monitoring (days):	-					
~	Mass of contaminant remov	ved:						
<u>x</u>		liquid pumping:			lb	kg	<u>x</u>	Unknown
		apor stream:			lb	kg	<u>x</u>	Unknown
	Tota				lb	kg	<u>x</u>	Unknown
	. 544						-	
	Comments:							
								
	Attachments:							

The	rmal Treatment - Design								Facility	ID#:	0810)
<u>x</u>	Thermal treatment:		Conduct	ive								
		<u>x</u>	Electrica	al Resistance	Easement N	<u>lorth</u>						
			_	3 phase		6 phase		AC power		DC	power	
			Steam									
			_	Steam		Steam + air		Steam + O2				
			Other (d	escribe)								
<u>x</u>	Type of Test: <u>x</u>	Pilot	test	Ful	l-scale System							
<u>x</u>	Geology of Treatment Zone	e:	_	Relativel	y homogened	ous and permea	ble unc	onsolidated	sedime	ents		
					-	ous and imperme						
			_	_		diments with into					•	
			<u>X</u>			sediments with i			of high	er pern	neabilit	y material
			_			red bedrock (i.e	-	lline rock)				
			_			mestone, sands	stone					
<u>x</u>	Treatment Targe Zone:			ed only	Vado	•		Both (Satura	ited and	Vadose	zones)	
<u>X</u>	Start of Thermal Test:	Oct-9				Duration:	39 mc	onths				
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No								
<u>x</u>	Treatment Cell Design:											
	Size of target zone (ft2):							Unkno	own	(_ x	ft)
	Thickness of target zone (f	t):			<u>22</u>			Unkno	own			
	Depth to top of target zone	(ft bgs	s):		<u>2</u>			Unkne	own			
	Thickness of target zone be	elow w	ater tabl	e (ft):	<u>12</u>			Unkne	own			
	Number of energy delivery	points	:		<u>12</u>			Unkne	own			
	Number of extraction points	s:			<u>25</u>			Unkno	own			
<u>x</u>	Temperature Profile:											
_	Initial formation temperatur	e (deg	C):						<u>x</u> U:	nknown		
	Maximum representative for	ormatic	n tempe	rature (deg (C):				<u>x</u> U	nknown		
	Time to reach maximum re	preser	ntative te	mperature (days):				<u>x</u> U:	nknown		
	Duration of treatment at rep	oresen	tative te	mperature (d	lays):				<u>x</u> U	nknown		
									_			-
	Formation temperature imr	nediate	ely post-	treatment:		<u>Dat</u>	<u>te</u>		Tem	peratur	e (deg	<u>(C)</u>
	Formation temperature pos				nt 1:							
	Duration of post-treatment			-								
<u>x</u>	Mass of contaminant remo	ved.										
^			oumping:					lb	kg	r	<u>x</u>	Unknown
		apor st							kg		<u>x</u>	Unknown
	Tota		rouni.						kg		<u>x</u>	Unknown
	1018							10	K	,	^	Clikilowii
	Comments:											
	Attachments:											

The	rmal Treatment - Design					Facility ID#	t: <u>0810</u>	<u>)</u>
<u>x</u>	Thermal treatment:	Conductive						
		<u>x</u> Electrical Resistance	Easement So	<u>uth</u>				
		3 phase	6	ó phase	AC pow	er	DC power	
		Steam						
		Steam		Steam + air	Steam +	O2		
		Other (describe)	-					
<u>x</u>	Type of Test: <u>x</u>	Pilot test Full-	-scale System					
<u>x</u>	Geology of Treatment Zone	e: Relatively	homogeneou	is and permeat	ole unconsolida	ited sediments		
		Relatively	homogeneou	is and imperme	eable unconsol	idated sedimer	nts	
		Largely p				•	-	
		Largely in					permeabilit	ty material
		Competer				k)		
				nestone, sands				
<u>X</u>	Treatment Targe Zone:	Saturated only	Vadose	•		iturated and Vac	lose zones)	
<u>X</u>	Start of Thermal Test:	Oct-98		Duration:	39 months			
<u>x</u>	Hydraulic Control	<u>X</u> YesNo						
<u>x</u>	Treatment Cell Design:							
Δ	Size of target zone (ft2):				Ui	nknown (x	ft)
	Thickness of target zone (ft	t):	22		·	nknown	_ ^	10)
	Depth to top of target zone	•	2		U			
	Thickness of target zone be		<u>12</u>		Uı	nknown		
	Number of energy delivery		9		Uı			
	Number of extraction points	s:	<u>36</u>		Uı	nknown		
<u>x</u>	Temperature Profile:							
	Initial formation temperature	re (deg C):	-			<u>x</u> Unkn	own	
	Maximum representative fo	ormation temperature (deg C	5): _			<u>x</u> Unkn	own	
	Time to reach maximum rep	presentative temperature (d	ays):			<u>x</u> Unkn	own	
	Duration of treatment at rep	presentative temperature (da	ays): _			<u>x</u> Unkn	own	
				Date	•	Tompo	ature (deg	· C)
	Formation temperature imm	nediately post-treatment:		Date	<u> </u>	<u>r emper</u>	alure (ueg	<u>(C)</u>
	·	st-treatment monitoring even	+ 1·					
	Duration of post-treatment	_	_					
	•	3 () /	_					
<u>x</u>	Mass of contaminant remov	ved:						
	Via I	liquid pumping:			lb	kg	<u>x</u>	Unknown
	In va	apor stream:			lb	kg	<u>x</u>	Unknown
	Tota	al:			lb	kg	<u>x</u>	Unknown
	Commente							
	Comments:							
	Attachments:							

and Performance					Facility ID#:	<u>0810</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_						
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k¹	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:				күүшүүс
	1 lease	note other energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
Th	ermal Vendor Cost:					
	ergy Cost:	'		m³	_ yd³	
	her Cost 1:				_,-	
	her Cost 1:	-				
	her Cost 3:					
Oil		Other Cost 1:				
riease note of		Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	10/26/2006
	Type of treatment:	<u>x</u> Conductive		Steam	ERH	Other:		
	Type of Contaminant:	Chlorinated So	lvents	<u>x</u>	Petroleum Hydro	carbons	Pesticides	S
		Wood Treating	;		Other:			
	Treatment Status:	Active	<u>x</u>	Post				
	Type of Test:	Pilot Test		Full Scale	e System			
	Start of Test:			_ End	of Test:		_ Duration:	
	Type of Site:	x Non-DOD		DoD				
<u>x</u>	Facility Name: Shell's Gas	smer Rd; R&D Facility						
	Address:							
	City, State, Zip Code:	<u>TX</u>						
	OU# or Site #:							
<u> </u>	Primary point of contact:	Denis Conley						
	Organization: Haley & A	Aldrich						
	Address: 200 Town Centre	re Dr.						
	City, State, Zip Code:	Rochester, NY 14622	3					
	Phone #: <u>585-321-4246</u>			email: dco	nley@haleyaldrich.co	<u>m</u>		
	_ Other contacts or vendors wh	ho worked on site			None			
	Point of contact:							
	Type:Vendor, C	Consultant	Vei	ndor, Techni	cal Applications	Otl	ner	
	Organization:							
	Address:							
	City, State, Zip Code:							
	Phone #:		_	email:				
Q	A/QC							
	Characteristics of Interest	ì						
	Good pre- and post-tre		ıta		Good pre-	and post-treatme	nt soil data	
	Good temperature prof	-			Flux assess	•		
	Groundwater elevation					ross-section		
	Hydraulic Conductivity				50010510 0			
	iiyaraane conductivit	. J 111101111111111111111111111111111111						

<u>0815</u>

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0815</u>
Impacted	Impacted zone a	v direction)(ft.):			ness (ft):		Unknown
	Alternative meth		pacted zone (See source zo	ne definition attachmer	nts)		
Monitor V	Vells: Number of relevant m	nonitoring wells with groundy			Deather to the second		None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
Types of 0	Contaminants						
				Average Pre-treatme	ent Concentration per	Average Post-treatm Chen	ent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None		None	None
	1,1-dichloroethene	Napthalene		None	None None None None None None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
							
Attachmer	nts:						

Geology: Zone	Hydrogeolo	gic Conceptual N	Model		Facility ID#: 0815
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded largers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, ilmestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded largers of higher permeability material Largely impermeable sediments with inter-bedded largers of higher permeability material Largely impermeable sediments with inter-bedded largers of higher permeability material Largely impermeable sediments with inter-bedded largers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: [1 ams] [1 ams] [1 ams] [1 ams] Aquifer Characteristics: Is more than 1 aquifer present? [1 Aquifer 2 Aquifer 3 Aquifer 3 Aquifer 1 Aquifer 2 Aquifer 3 Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): [1 ams]	Geold	ogy:	<u>Zone</u>	<u>Unconsolidated Sediments</u>	
Largely impermeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, imestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Iow value (ft bgs): high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Weathered bedrock, imestone, sandstone I amsl Unknown Unknown Unknown Unknown Linknown			Vadose Zone:	Relatively homogeneous and permeable unconsolidated	sediments
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded laness of lower permeability material Largely impermeable sediments with inter-bedded laness of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Inknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Iow value (it bgs): high value (it bgs): Unknown Horizontal hydraulic gradient (fleet/foot): Unknown Horizontal hydraulic gradient (fleet/foot): Weathered bedrock, limestone Linknown Li				Relatively homogeneous and impermeable unconsolidate	d sediments
Competent, but fractured bedrock, (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: Iow value (It bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Weathered bedrock, limestone, sandstone It smsl Unknown Unknown Unknown Unknown Vertical hydraulic gradient (feet/foot): Weathered bedrock, limestone, sandstone It smsl Unknown Unknown Unknown Unknown Flow direction Horizontal hydraulic gradient (feet/foot): Juknown Negh Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Iow Juknown High Comments:				Largely permeable sediments with inter-bedded lenses of	lower permeability material
Weathered bedrock, limestone, sandstone Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Largely permeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: fr amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): Unknown: Unknown: Unknown: Unknown: Unknown: Unknown Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown high Slug Test Laboratory Field data				Largely impermeable sediments with inter-bedded layers	of higher permeability material
Saturated Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded losses of lower permeability material Largely impermeable sediments with inter-bedded losses of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: if amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1				Competent, but fractured bedrock (i.e. crystalline rock)	
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): Inigh value (Weathered bedrock, limestone, sandstone	
Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Is more than 1 aquifer present? No Yes (number): Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): K range (ft/day) Measured using: Slug Test Laboratory Field data low Linknown Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Low Linknown			Saturated Zone:	Relatively homogeneous and permeable unconsolidated	sediments
Largely impermeable sediments with inter-bedded layers of higher permeability material				Relatively homogeneous and impermeable unconsolidate	d sediments
Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: fit amsl Unknown Aquifer Characteristics: Is more than 1 aquifer present? No Yes (number): Unknown (assume single aquifer) Aquifer 1				Largely permeable sediments with inter-bedded lenses of	lower permeability material
				Largely impermeable sediments with inter-bedded layers	of higher permeability material
Ground surface elevation based on wells in or adjacent to treatment zone: ft amsl Unknown				Competent, but fractured bedrock (i.e. crystalline rock)	
Aquifer Characteristics: Is more than 1 aquifer present?NoYes (number):				Weathered bedrock, limestone, sandstone	
Aquifer Characteristics: Is more than 1 aquifer present?NoYes (number):					
Is more than 1 aquifer present?NoYes (number):Unknown (assume single aquifer) Aquifer 1	Groun	nd surface elevat	ion based on wells in o	adjacent to treatment zone: ft amsl	Unknown
Is more than 1 aquifer present?NoYes (number):Unknown (assume single aquifer) Aquifer 1					
Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs):	Aquif	er Characteristics	s:		
Depth to water: low value (ft bgs): high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Lunknown K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Comments:	Is mo	re than 1 aquifer	present?	No Yes (number):	Unknown (assume single aquifer)
high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown High Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown High Comments:				Aquifer 1 Aquifer 2 Aquifer 3	
Unknown: — Flow direction — Horizontal hydraulic gradient (feet/foot): — Unknown Vertical hydraulic gradient (feet/foot): — Unknown — K range (ft/day) — Measured using: — Slug Test — Laboratory — Field data — Unknown — high — — — — — Field data — low — — — — — Field data — — — — — — — — — — — — — — — — — — —	Depth	n to water:	low value (ft bgs):		_
Flow direction Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): K range (ft/day) Measured using: Slug Test Laboratory Field data low Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Laboratory Field data Low Unknown high Comments:			high value (ft bgs):		_
Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: Slug Test Laboratory Field data Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Comments:			Unknown:		_
Horizontal hydraulic gradient (feet/foot): Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: Slug Test Laboratory Field data Unknown high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Unknown Laboratory Field data Unknown high Comments:					
Vertical hydraulic gradient (feet/foot):	Flow	direction			_
Vertical hydraulic gradient (feet/foot):					
K range (ft/day) Measured using: Slug TestLaboratoryField data Unknown high Transmissivity (ft2/day): Measured using:Slug TestLaboratoryField data Unknown highUnknown high					
low	Vertic	al hydraulic grad	ient (feet/foot):		Unknown
low					
high Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Comments:	K ran	ge (ft/day)	Measured	using: Slug Test Laboratory	Field data
Transmissivity (ft2/day): Measured using: Slug Test Laboratory Field data Unknown high Comments:			low		Unknown
lowUnknown high			· ·		_
high	Trans	missivity (ft2/day): Measured	using: Slug Test Laboratory	Field data
Comments:			low		Unknown
			high		_
Attachments:	Comr	ments:			
Attachments:					
Attachments:					
	Attacl	nments:			

The	ermal Treatment - Design					Facility ID#:	<u>0815</u>		
<u>x</u>	Thermal treatment:	x Conductive _							
		Electrical Resistanc	e						
		3 phase	·	6 phase	AC power	DC	power		
		Steam							
		Steam		Steam + air	Steam + O2				
		Other (describe)							
<u>x</u>	Type of Test: <u>x</u>	Pilot test F	Full-scale System						
_	_ Geology of Treatment Zone	e: Relativ	ely homogeneo	us and permeabl	le unconsolidated	sediments			
		Relativ	ely homogeneo	us and imperme	able unconsolidate	ed sediments			
		- '				•	-		
		Largel	y impermeable s	sediments with in	ter-bedded layers	of higher perm	neability material		
				ed bedrock (i.e.					
				mestone, sandsto	one				
	_ Treatment Targe Zone:	Saturated only	Vados	-					
	_ Start of Thermal Test:			Duration:					
_	_ Hydraulic Control	Yes N	No						
	Tractment Call Decima								
_	_ Treatment Cell Design:				77.1		6)		
	Size of target zone (ft2):	ω \.	-		Unkno	-	x ft)		
	Thickness of target zone (f								
	Depth to top of target zone Thickness of target zone be								
	Number of energy delivery								
	Number of extraction points					oz inted sediments dated sediments as of lower permeability material yers of higher permeability mater k) inturated and Vadose zones) inknown inkno			
	Number of extraction points	3.			Olikilo	wii			
	_ Temperature Profile:								
	Initial formation temperatur	re (dea C):				Unknown			
	Maximum representative for		q C):						
	Time to reach maximum re		- '						
	Duration of treatment at rep					Unknown			
	·	•	. , ,						
				<u>Date</u>		Temperatur	e (deg C)		
	Formation temperature imr	mediately post-treatment:							
	Formation temperature pos	st-treatment monitoring ev	vent 1:						
	Duration of post-treatment	monitoring (days):							
	_ Mass of contaminant remo	ved:							
	Via	liquid pumping:			lb	kg	Unknown		
	In va	apor stream:			lb	kg	Unknown		
	Tota	al:			lb	kg	Unknown		
	Comments:								
	Attachments:								

and Performance					Facility ID#:	<u>0815</u>
_ Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
_	·					
	Comment: —					
	<u> </u>					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
-						
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Whr/vd ³
	tal energy applied to t	reatment zone:	ĸ ‹‹ iii		kWhr/m³	kWhr/yc
	ner energy:				_ kWhr/m ³	kWhr/yc
Ott					_ KVVNr/m	KVVNI/yd
	Please	note other energy:				-
Cost						
Total Project Cost:						
-	nsultant Cost:					
	ermal Vendor Cost:					
					_ yd³	
	ergy Cost:			m	_ ya	
	ner Cost 1:					
	her Cost 2:					
· · · · · · · · · · · · · · · · · · ·	ner Cost 3:	-				
Please note of	ther cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

File Analyzed By: PD ____ Date: 1/25/2007 Type of treatment: _ Conductive Steam ERH ____Other: Type of Contaminant: _____Pesticides _Chlorinated Solvents Petroleum Hydrocarbons ___Wood Treating Other: Treatment Status: _Active Post Type of Test: Pilot Test Full Scale System Start of Test: 1997 End of Test: 1997 Duration: varied Type of Site: DoD Non-DOD <u>X</u> Facility Name: Ft. Hood / Robert Gray Army Field City, State, Zip Code: Killian, TX OU# or Site #: Primary point of contact: Book: Steam and Electroheating Remediation of Tight Soils Organization: copyright 2000 by CRC Press, LLC Address: City, State, Zip Code: Phone #: email: __ Other contacts or vendors who worked on site _None Point of contact: Dr. C. Herb Ward Type: _ Vendor, Consultant _____ Vendor, Technical Applications __Other Organization: Rice University Address: City, State, Zip Code: Phone #: <u>713-348-4086</u> email: wardch@rice.edu QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0820

General Site Information

General Site Ass	sessment Data					Facility I	D#: <u>0820</u>
Impacted 2	0 "		Width (ft):	Thick	rness (ft):		Unknown
		as defined by documentation					
		nod for determining size of im	pacted zone (See source z	one definition attachme	nts)		
	Map attachment	t					
<u>x</u> Monitor W	/ells: Number of relevant n	monitoring wells with groundy	vater data:				None
_		, , , , , , , , , , , , , , , , , , ,	Pre-treatment	: 1	Post-treatment:	1	
	Number of wells related	tive to treatment zone:		_		_	
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment		Upgradient:	Downgradient:		ssgradient:	
				Ü			
x Soil Boring	s: Number of relevant so	oil borings with pre-treatment	data: <u>7</u>				
	Number of relevant so	oil borings with post-treatmen	t data: <u>5</u>				
	Number inside treatm	nent zone: 7 / 5	Number outsid	le treatment zone:	<u>0</u>		
x Types of C	ontaminants		T	1		T	
					ent Concentration per mical:		nent Concentration per mical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane	x Petroleum		None	1,000 mg/kg	None	100 mg/kg
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Commer	nts:						
			Cross-se	cton on pag 9-12			
	of 19919.58					Pre-treatm	ent mass estimate
	01 19919.58	pounds					
Attachmen							
Allaciilleli							

Impacted Z	one: Length (parallel to flo	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
	Alternative met	nod for determining size of im	npacted zone (See source	e zone definition attachmen	its)		
	Map attachmen	t					
Monitor We	ells: Number of relevant	monitoring wells with ground	water data:				None
			Pre-treatme	ent: <u>1</u>	Post-treatment:	1	
		tive to treatment zone:		5	•		
	Pre-treatment	In:	Upgradient:			ssgradient:	
	Post-treatment	In:	Upgradient:	_ Downgradient:	Cro	ssgradient:	
Soil Borings	S: Number of relevant s	oil borings with pre-treatment	data:	11			
		oil borings with post-treatmer	nt data:	7			
	Number inside treatm	ent zone: 11 / 7	Number ou	tside treatment zone:	<u>0</u>		
Types of Co	oniaminants						
				Average Pre-treatme Chen		Average Post-treatm Chem	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
_	Trichloroethene	Hexane	Creosote	None	None	None	None
_	Tetrachloroethene	Jet Fuel		None	None	None	None
_	1,1-dichloroethene	Napthalene		None	None	None	None
-	cis-1,2-dichloroethene	Benzene		None	None	None	None
-	trans-1,2-dichloroethene	Tolune		None	None	None	None
-	1,1-dichloroethane	Ethylbenzene		None	None	None	None
-	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene 10tat recoverable		None	None	None	None
Concern	1,1,2-trichloroethane	x <u>Petroleum</u>		None	1,000 mg/kg	None	100 mg/kg
-	1,1,2,2-tetrachloroethane			None	None	None	None
_	Vinyl Chloride			None	None	None	None
-				None	None	None	None
-				None	None	None	None
-				None	None	None	None
-	 .			None	None	None	None
-				None	None	None	None
<u>.</u>				None	None	None	None
Comment	ts:						
			Cross	-secton on pag 9-12		Pre-treatme	ent mass estimate
	of 8984.92	pounds				7 16-11681111	maos ssiimate
Attachments							

Impacted Z	one: Length (parallel to flo	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
	Alternative met	hod for determining size of in	npacted zone (See sourc	e zone definition attachmen	ts)		
	Map attachmen	t					
Monitor We	ells: Number of relevant	monitoring wells with ground	water data:				None
			Pre-treatme	ent: <u>4</u>	Post-treatment:	<u>4</u>	
	Number of wells rela Pre-treatment	ative to treatment zone:	l la ava di anti	Downwardiant	0	an are dient.	
	Post-treatment		Upgradient: Upgradient:	Downgradient: Downgradient:		ssgradient:ssgradient:	
	Post-treatment		opgradient	Downgradient.		ssgradient.	
Soil Borings	S: Number of relevant s	oil borings with pre-treatmen	t data:	11			
	Number of relevant s	oil borings with post-treatmen	nt data:	7			
	Number inside treatm	nent zone: 11 / 7	Number out	tside treatment zone:	<u>0</u>		
Types of Co	ontaminants						
				Average Pre-treatme Chen		Average Post-treatme	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
-	Trichloroethene	Hexane	Creosote	None	None	None	None
-	Tetrachloroethene	Jet Fuel		None	None	None	None
-	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
-	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Observiced set	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane	x Petroleum		None	1,000 mg/kg	None	50 mg/kg
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
-				None	None	None	None
-				None	None	None	None
-				None	None	None	None
-				None	None	None	None
-				None	None	None	None
				None	None	None	None
Commen	IS:						
			Cross-	-secton on pag 9-12	_		
	of 3234.38	pounds				Pre-treatme	nt mass estimate
		- <u> </u>					-
Attachments	s:						

Нус	Irogeologic Conceptua	l Model				Facility ID#:	0820
X	Geology:	Zone Vadose Zone: Saturated Zone:	X Relatively hon Largely perme Largely imperi Competent, bi Weathered be Relatively hon X Relatively hon Largely perme Largely imperi Competent, bi	diments nogeneous and permea nogeneous and imperm hable sediments with int meable sediments with ut fractured bedrock (i.e. drock, limestone, sand- nogeneous and permea nogeneous and imperm hable sediments with int meable sediments with ut fractured bedrock (i.e. drock, limestone, sand-	terable unconsolidated der-bedded lenses of keinter-bedded layers of a crystalline rock) stone able unconsolidated set leable unconsolidated der-bedded lenses of keinter-bedded layers of a crystalline rock)	sediments ower permeability mate f higher permeability mate ediments sediments ower permeability mate	aterial erial
<u>x</u>	Ground surface elev	ration based on wells in	or adjacent to treatme	nt zone:	ft amsl	<u>x</u> Unknov	wn
<u>X</u>	Aquifer Characterist Is more than 1 aquif		No N	Yes (number): Aquifer 2	U	Jnknown (assume single a	aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	9.5 18	<u> </u>		- -	
<u>x</u>	Flow direction		<u>E</u>			-	
	_ Horizontal hydraulic Vertical hydraulic gr					Unknov Unknov	
x	K range (ft/day) Transmissivity (ft2/d	Measured low high ay): Measured	5.95E-06 9.30E-05	0.28	boratory	Field dataUnknovField data	wn
		low high				Unknov	wn

K=3.3e-8 to 2.1e-

Comments:

Attachments:

K = 1e-4 cm/sec for weathered

shale/limestone 9 cm/sec for slug tests.

The	rmal Treatment - [Design									Fa	cility ID#:	0820	
<u>x</u>	Thermal treatme	ent:		Conductive	·									
			<u>x</u>	Electrical I	Resistance	Cell A								
					_ 3 phase	_	6 phase			AC pov	wer	D	C power	
				Steam										
					Steam	_	Steam +	air		Steam	+ O2			
				Other (des	cribe)									
<u>x</u>	Type of Test:	<u>x</u>	Pilot t	est	Full	-scale Sys	tem							
<u>x</u>	Geology of Trea	tment Zone:	:		_ Relatively	/ homoge	neous and p	permeab	le un	consolid	lated se	diments		
				<u>X</u>	-	_	neous and i	-						
							sediments					•	-	
							ole sedimen					nigner pe	rmeability	material
					-		ctured bedr		-	alline ro	CK)			
v	Treatment Targe	70no:		Saturated	_		k, limestone adose only	, sanusi		Doth (Coturated	and Vados	o zonos)	
<u>x</u>	Start of Thermal			7 (ended	-	·	-	uration:	<u>X</u>		aturateu	and vados	se zones)	
^	Hydraulic Contro	•	<u> </u>		No			aration.	O IIIO	<u>ntiis</u>				
	,													
<u>x</u>	Treatment Cell [Design:												
	Size of target zo	ne (ft2):				900				t	Jnknowr	n (<u>30</u> x	30 ft)
	Thickness of targ	get zone (ft):	:			<u>24</u>				t	Jnknowr	1		
	Depth to top of to	arget zone (ft bgs):						t	Jnknowr	1		
	Thickness of targ	get zone bel	low wa	ater table	(ft):					t	Jnknowr	1		
	Number of energ	gy delivery p	oints:			<u>6</u>				—т	Jnknowr	1		
	Number of extra	ction points:	:			4				[[]	Jnknowr	1		
<u>x</u>	Temperature Pro	ofile:												
_	Initial formation t	temperature	(deg	C):			20.5					Unknov	vn	
	Maximum repres	sentative for	matio	n tempera	ture (deg C	:):	<u>54.4</u>				_	Unknov	vn	
	Time to reach m	aximum rep	resen	tative tem	perature (d	ays):					_	Unknov	vn	
	Duration of treat	ment at repr	resent	ative temp	erature (da	ays):					_	Unknov	vn	
								Date	<u>)</u>			Temperat	ure (deg	<u>C)</u>
	Formation temper	erature imme	ediate	ly post-tre	atment:									
	Formation temper	erature post-	-treatr	nent moni	toring even	nt 1:					_		-	
	Duration of post-	-treatment m	nonito	ring (days):						_			
<u>x</u>	Mass of contami	inant remove	ed:											
_		Via lic	quid p	umping:						lb		kg		Unknow
		In vap	oor str	eam:				_		lb	_	kg		Unknow
		Total:	:			<u>15</u>	150		<u>x</u>	lb		kg		Unknowi
	Comments:	<u>Hydraulic l</u>	Fract	ures at 12	2, 15, 18, a	and 21 ft	<u>-</u>							
		upgradient	t (GV	/-A)								GW re	ecovery v	vell was Pos
		mass of 47												
	Attachments:													

The	rmal Treatment - [Design								Facility ID#:	<u>0820</u>
<u>x</u>	Thermal treatme	ent:		_ Condu	ctive						
				Electri	cal Resistance						
					3 phase		6 phase		_ AC power	DC	C power
		2	<u>X</u>	Steam	Cell B						
					Steam		Steam + air	_	_ Steam + O2	2	
		-		Other	(describe)						
<u>x</u>	Type of Test:	<u>x</u> 1	Pilot	test	Ful	l-scale S	ystem				
<u>x</u>	Geology of Trea	tment Zone:			Relativel	y homo	geneous and perr	neable ur	nconsolidate	d sediments	
					_	•	geneous and impo				
				•			ole sediments with				•
				•						s of higher per	meability material
							fractured bedrock		(alline rock		
	T	. 7		0-1			ock, limestone, sa		D 1/0	. 1 177 1	
<u>X</u>	Treatment Targe Start of Thermal	-			ated only	-	Vadose only			rated and Vadose	
<u>X</u>	Hydraulic Contro	-	Apr-	<u>97</u> _ Yes	No		Durat	ion:			
	_ r iyuradiic Contic			_ 1 cs	NO						
<u>x</u>	Treatment Cell D	Design:									
_	Size of target zo	_				<u>570</u>			Unkr	nown (24 x 24 ft)
	Thickness of targ		:			22			Unkr		
	Depth to top of to	arget zone (f	ft bg	s):					Unkr	nown	
	Thickness of targ	get zone bel	ow v	vater ta	ble (ft):				Unkr	nown	
	Number of energ	gy delivery p	oints	s:		<u>4</u>			Unkr	nown	
	Number of extra	ction points:				<u>4</u>			Unkr	nown	
<u>x</u>	Temperature Pro	ofile:									
	Initial formation t	temperature	(deg	g C):			<u>21</u>			Unknow	n
	Maximum repres			-						Unknow	
	Time to reach m	•					-			Unknow	
	Duration of treat	ment at repr	eser	ntative 1	temperature (d	ays):				Unknow	n
								Doto		Temperatu	uro (dog C)
	Formation temper	erature imme	adiat	elv nos	t-treatment			<u>Date</u>		remperati	ire (deg C)
	Formation temper					nt 1·					
	Duration of post-	-			-						
	, , , , , , , , , , , , , , , , , , , ,			3 (1	-,						
<u>x</u>	Mass of contami	inant remove	ed:								
		Via liq	quid	pumpin	g:				_ lb	kg	Unknown
		In vap	or s	tream:	_				_ lb	kg	Unknown
		Total:					<u>7820</u>	<u>x</u>	lb	kg	Unknown
		Hydraulic F	Frac	tures a	at 12, 15, 18,	and 21	ft.				
	Comments:	(SIM) was	con	nnleten	lat 16 ft					the steam in	njection well GW
					gradient (GW					_	
										Post m	ass of 1165.37
	Attachments:										
								•	•		

The	rmal Treatment - [Design								Facility ID#	:: <u>082</u>	0
<u>x</u>	Thermal treatme	ent:		_ Conducti	ve							
		-		Electrica	l Resistance							
				_	3 phase	-	6 phase		_ AC power		DC power	
		2	<u>x</u>	Steam	Cell C							
				_	Steam	-	Steam + air		_ Steam + C)2		
		-		Other (de	escribe)							
<u>x</u>	Type of Test:	<u>x</u> 1	Pilot	test	Full-	-scale Sy	stem					
<u>x</u>	Geology of Trea	tment Zone:		_	Relatively	homoge	eneous and per	meable un	consolidate	ed sediments		
				<u>X</u>	Relatively	/ homoge	eneous and imp	ermeable	unconsolid	ated sedimen	its	
				_			e sediments wit			-	-	
				_			able sediments				ermeabili	ty material
				_			actured bedrock		alline rock)			
	T	. 7		0-11-			ck, limestone, s		D 1 (C)	. 1 177 1		
<u>X</u>	Treatment Targe	-			ed only led 9/5/97)	— `	•	<u>X</u>		irated and Vad	ose zones)	
<u>X</u>	Start of Thermal Hydraulic Contro	-		_ Yes	No		Dula	tion: <u>67 d</u>	<u>ays</u>			
	_ r ryuraulic Cornic			_ 165	No							
<u>x</u>	Treatment Cell [Design:										
_	Size of target zo	•				<u>580</u>			Unk	nown (<u>24</u> x	24 ft)
	Thickness of tar					22			Unk		_	- /
	Depth to top of t	arget zone (f	ft bg	s):					Unk	nown		
	Thickness of tar	get zone bel	ow v	water table	e (ft):				Unk	nown		
	Number of energ	gy delivery p	oints	s:		<u>11</u>			Unk	nown		
	Number of extra	ction points:				<u>5</u>			Unk	nown		
<u>x</u>	Temperature Pro	ofile:										
	Initial formation	temperature	(deg	g C):			<u>20.5</u>			Unkno	own	
	Maximum repres			-			93.3			Unkno		
	Time to reach m	•					-			Unkno		
	Duration of treat	ment at repr	eser	ntative ter	nperature (da	ays):				Unkno	own	
								Data		Tompor	ature (ded	7 C\
	Formation temper	erature imme	adiat	tely nost-t	reatment:			<u>Date</u>		remper	ature (uet	<u>10)</u>
	Formation temper					ıt 1·						
	Duration of post	•			_							
				3 (**)	-,							
<u>x</u>	Mass of contami	inant remove	ed:									
		Via liq	uid	pumping:					_ lb	kg	_	Unknown
		In vap	or s	tream:					_ lb	kg	_	_ Unknown
		Total:				2	<u> 2766</u>	<u>x</u>	lb	kg	_	_ Unknown
		ı ıyuraulıcı	ıau	nuico ai	14, 10, 10, 0	211U <u> </u>	<u>ı. </u>					
	Comments:	(SIM) was	con	npleted a	t 15 and 18	ft and a	nt 12ft			the steam	ı injectior	<u>well</u> GW_
					adient (GW					Door	maca of	<u>_</u>
	Attachments:									POSI	t mass of	400.30
	Allauminems.											

D		Facility ID#: 0820
٢	erformance	
Re	emediation Goal:	
	In Groundwate	r:
	In Soil:	
W	as the Remediation Goal Achieved:	
	In Groundwate	т
	Commen	
	In Soil	
	Commen	tt:-
		·
_		
G	eneral comments on the thermal ap	plication:
		5 ft apart (center to center) and cells B and C were spaced 31 ft apart (center to center).
		he viability of newly developed remedaiton methods and to promote more widespread use
	3) id design characteristics impo	s. Objectives: 1) reduce TRPH to 1000 mg/kg or less 2) measure extent of treatmer ortant for site selection and scale-up and 4) determine operating costs under normal co
): 1) determine recovery rates of vapor and liquide 2) determine distribution of extracted
		phase chromatographic boil point analysis and 3) determine if heating (soil) front could be
⊑r,	and SVOCs by means of vapor- monitored by measurements of	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be
	and SVOCs by means of vapor- monitored by measurements of nergy	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature.
	and SVOCs by means of vapor- monitored by measurements of mergy otal Energy Used: 176	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. X kWhr kWhr/m³ kWhr/yd³
	and SVOCs by means of vapor- monitored by measurements of mergy otal Energy Used: Total energy applied	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
	and SVOCs by means of vapor- monitored by measurements of nergy otal Energy Used: Total energy applied Other energy:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
	and SVOCs by means of vapor- monitored by measurements of nergy otal Energy Used: Total energy applied Other energy:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
_ Co	and SVOCs by means of vapor- monitored by measurements of mergy total Energy Used: Total energy applied Other energy: Ples	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
_ Co	and SVOCs by means of vapor- monitored by measurements of mergy total Energy Used: Total energy applied Other energy: Plest otal Project Cost:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
_ Co	and SVOCs by means of vapor- monitored by measurements of nergy otal Energy Used: 176 Total energy applied Other energy: Ples otal Project Cost: Consultant Cost:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
To	and SVOCs by means of vapor- monitored by measurements of mergy total Energy Used: 176 Total energy applied Other energy: Ples total Project Cost: Consultant Cost: Thermal Vendor Cost	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
To	and SVOCs by means of vapor- monitored by measurements of mergy total Energy Used: Total energy applied Other energy: Ple: ost otal Project Cost: Consultant Cost: Energy Cost:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
To	and SVOCs by means of vapor- monitored by measurements of nergy otal Energy Used: 176 Total energy applied Other energy: Ples ost otal Project Cost: Consultant Cost: Thermal Vendor Cost Energy Cost: Other Cost 1:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
_ Co	and SVOCs by means of vapor- monitored by measurements of mergy total Energy Used: Total energy applied Other energy: Ples ost otal Project Cost: Consultant Cost: Thermal Vendor Cost Energy Cost: Other Cost 1: Other Cost 2:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
_ Co	and SVOCs by means of vapor- monitored by measurements of nergy otal Energy Used: 176 Total energy applied Other energy: Ples ost otal Project Cost: Consultant Cost: Thermal Vendor Cost Energy Cost: Other Cost 1:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
To	and SVOCs by means of vapor- monitored by measurements of mergy total Energy Used: Total energy applied Other energy: Ples ost otal Project Cost: Consultant Cost: Thermal Vendor Cost Energy Cost: Other Cost 1: Other Cost 2:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12
To	and SVOCs by means of vapor- monitored by measurements of mergy total Energy Used: Total energy applied Other energy: Ple: ost otal Project Cost: Consultant Cost: Thermal Vendor Cost Energy Cost: Other Cost 1: Other Cost 2: Other Cost 3:	phase chromatographic boil point analysis and 3) determine if heating (soil) front could be soil temperature. S12

File Analyzed By: PD ____ Date: 11/14/2006 Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents _ Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: 1997 End of Test: 1997 Duration: _____ Type of Site: DoD ____Non-DOD Facility Name: <u>Hill Air Force Base</u> Address: City, State, Zip Code: Odgen, UT OU# or Site #: OU-1 Primary point of contact: Dr. Lloyd Stewart Organization: Address: City, State, Zip Code: Phone #: 877-763-8564 email: bo@praxis-enviro.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0830

General Site Information

General Site As	sessment Data					Facility II	D#: <u>0830</u>
Impacted		v direction)(ft.): s defined by documentation		Thick	ness (ft):	<u></u>	Unknown
		•	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment				•		
Monitor V	Vells: Number of relevant m	nonitoring wells with grounds	vater data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	ive to treatment zone:	i io doddione.		r ost treatment.		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	nt data:				
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Types of C	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ents:						
				•		•	
Attachmer	nts:						

ogeologic Conce	ptual Model								
Geology:	Zone		Unconsol	idated Sedim	nents_				
	Vadose Zor	ne:	Rela	atively homog	eneous and pe	ermeable unc	onsolidated s	ediments	
			Rela	atively homog	eneous and im	permeable u	nconsolidated	sediments	
			<u>x</u> Larg	jely permeab	le sediments w	ith inter-bedo	led lenses of l	ower permeab	oility material
			Larg	gely imperme	able sediments	with inter-be	edded layers o	of higher perme	eability material
			Con	npetent, but f	ractured bedroo	ck (i.e. crysta	lline rock)		
			Wea	athered bedro	ock, limestone,	sandstone			
	Saturated Z	Zone:	Rela	atively homog	jeneous and pe	ermeable unc	onsolidated s	ediments	
			Rela	atively homog	eneous and im	permeable u	nconsolidated	sediments	
			<u>x</u> Larg	jely permeab	le sediments w	ith inter-bedo	led lenses of l	ower permeab	oility material
			Larg	gely imperme	able sediments	with inter-be	edded layers o	of higher perme	eability material
			Con	npetent, but f	ractured bedroo	ck (i.e. crysta	lline rock)		
			Wea	athered bedro	ock, limestone,	sandstone			
Ground surface	elevation based or	n wells in o	r adjacent	to treatment a	zone:		ft amsl		Unknown
Ground surface Aquifer Charact Is more than 1 a Depth to water:	eristics:	 ft bgs):	No Aquife	Yes	(number):Aquifer :	2		Jnknown (assun	me single aquifer)
_Aquifer Charact	eristics: aquifer present? low value (f high value (ft bgs):	No	Yes	(number):	2		Jnknown (assun	_
Aquifer Charact Is more than 1 a Depth to water:	eristics: aquifer present? low value (f high value (ft bgs): (ft bgs):	No	Yes	(number):	2		Jnknown (assun	_
Aquifer Charact Is more than 1 a Depth to water: Flow direction Horizontal hydra	eristics: aquifer present? low value (f high value (Unknown:	ft bgs): (ft bgs): /foot):	No	Yes	(number):	2		Jnknown (assun	ne single aquifer)
Aquifer Charact Is more than 1 a Depth to water: Flow direction Horizontal hydra	eristics: aquifer present? low value (f high value (Unknown: aulic gradient (feet/foc	ft bgs): (ft bgs): /foot): ot): Measured	No Aquife	Yes	(number):	2Laboratory	Aquifer 3	Jnknown (assun	ne single aquifer) Unknown Unknown
Aquifer Charact Is more than 1 a Depth to water: Flow direction Horizontal hydraul	eristics: aquifer present? low value (f high value (Unknown: aulic gradient (feet/foc	ft bgs): (ft bgs): /foot): ot):	No Aquife	Yes	(number):		Aquifer 3	- - - -	ne single aquifer)
Aquifer Charact Is more than 1 a Depth to water: Flow direction Horizontal hydraul	eristics: aquifer present? low value (f high value (Unknown: aulic gradient (feet/foc	ft bgs): (ft bgs): /foot): ot): Measured	No Aquife	Yes	(number):		Aquifer 3	- - - -	ne single aquifer) Unknown Unknown
Aquifer Charact Is more than 1 a Depth to water: Flow direction Horizontal hydraul	eristics: aquifer present? low value (f high value (Unknown: aulic gradient (feet/foc	ft bgs): (ft bgs): /foot): ot): Measured low	No Aquife	Yes	(number):		Aquifer 3	- - - -	ne single aquifer) Unknown Unknown
Aquifer Charact Is more than 1 a Depth to water: Flow direction Horizontal hydra Vertical hydraul K range (ft/day)	eristics: aquifer present? low value (f high value (Unknown: aulic gradient (feet/foc	ft bgs): (ft bgs): /foot): bt): Measured low high	No Aquife	Yes	(number):	Laboratory	Aquifer 3	Field data	ne single aquifer) Unknown Unknown

The	rmal Treatment - Design							Faci	lity ID#:	0830	
<u>x</u>	Thermal treatment:		_ Condu	ctive							
			_ Electric	cal Resistance							
			-	3 phase	_	6 phase	AC po	ower	DC	power	
		<u>x</u>	Steam	-							
			-	Steam	_	Steam + air	Steam	+ O2			
.,	Turns of Toots	D'1		(describe)							
X	Type of Test: <u>x</u> Geology of Treatment Zone	Pilot	test	· <u> </u>	l-scale Syst	em neous and permea	bla unconcoli	datad cad	imonte		
<u>X</u>	Geology of Treatment Zone	;.	-			neous and imperm					
			-		-	sediments with int				ability n	naterial
						ole sediments with			•	•	
					•	ctured bedrock (i.e		-	0 1		,
			_	Weather	ed bedroc	k, limestone, sands	stone				
	_Treatment Targe Zone:		_ Satura	ated only	V	adose only	Both	Saturated a	nd Vadose	zones)	
	_Start of Thermal Test:					Duration:					
	_ Hydraulic Control		Yes	No							
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):				<u>160</u>			Unknown	(1	10 x	<u>16</u> ft)
	Thickness of target zone (ft):			<u>30</u>			Unknown			
	Depth to top of target zone	(ft bg	s):		<u>0</u>			Unknown			
	Thickness of target zone be			ble (ft):			_	Unknown			
	Number of energy delivery		S:		-		· <u>-</u>	Unknown			
	Number of extraction points	i:					<u>X</u>	Unknown			
	_ Temperature Profile:										
	Initial formation temperature	e (dec	a C).						_ Unknown		
	Maximum representative fo		-	erature (deg 0	C):				Unknown		
	Time to reach maximum rep								Unknown		
	Duration of treatment at rep								Unknown		
					• /						
						Dat	<u>te</u>	<u> </u>	emperatu	re (deg	<u>C)</u>
	Formation temperature imm	nediat	tely pos	t-treatment:							
	Formation temperature pos	t-trea	tment m	nonitoring ever	nt 1:						
	Duration of post-treatment i	monit	oring (d	ays):							
<u>x</u>	Mass of contaminant remov										
			pumping	g:			lb		_ kg	x	Unknown
			tream:		3	<u>34</u>	lb	<u>x</u>	kg		Unknown
	Tota	l:		_			lb		_ kg	<u>X</u>	Unknown
	Comments:										
	Attachments:										
	,doiiiioino.										
	-										

and Performance					Facility ID#:	<u>0830</u>
Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
						
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
-						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k¹	Whr/yd ³
	tal energy applied to t	reatment zone:			kWhr/m³	kWhr/yo
	her energy:				_ kWhr/m³	kWhr/yo
		note other energy:				kvviii/ye
	1 lease	note other energy.				
Cost						
Total Project Cost:						
Co	nsultant Cost:					
 Th	ermal Vendor Cost:					
	ergy Cost:	'		m³	_ yd³	
	her Cost 1:				_ , -	
	her Cost 1:	-				
	her Cost 3:					
Oil		Other Cost 1:				
riease note of		Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>x</u> PD ____ File Analyzed By: Date: 10/26/2006 ____Other: Type of treatment: ___ Conductive Steam ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ____ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: 3.5 Years Sep-00 Type of Site: ____Non-DOD DoD <u>X</u> Facility Name: Yorktown Naval Shipyards City, State, Zip Code: Norfolk, VA OU# or Site #: Primary point of contact: Linda Cole Organization: Address: City, State, Zip Code: Phone #: <u>752-322-4734</u> email: ____ Other contacts or vendors who worked on site _ None Point of contact: Jennifer Davis Type: __ Vendor, Consultant _____ Vendor, Technical Applications Other Organization: Navy Address: City, State, Zip Code: Phone #: <u>757-322-4775</u> email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0840

General Site Information

Ge	eneral Site As	sessment Data					Facility II	D#: <u>0840</u>
x	Impacted :	Impacted zone a	w direction)(ft.): <u>below</u> as defined by documentation			ness (ft):		Unknown
		Alternative meth		npacted zone (See source zo	ne definition attachment	ts)		
_	Monitor V	Vells: Number of relevant n	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
		Number of wells relat	tive to treatment zone:	i re-treatment.		ost-treatment.		
		Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
	Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:				
		Number of relevant so	oil borings with post-treatmer	nt data:				
		Number inside treatme	ent zone:	_ Number outside	treatment zone:			
<u>X</u>	Types of C	Contaminants			T			
					Average Pre-treatmer		Average Post-treatm Chen	ent Concentration per nical:
_		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
	Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,2-trichloroethane	x Bunker Fuel		None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
L					None	None	None	None
	Comme	nts:		8000 L of Bunker Fuel es	itimated to have been	<u>released</u>		
	Attachmen	its:						
	Allacille							
								-

Hyd	rogeologic Conceptua	ıl Model		Facility ID#: 0840
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated set Relatively homogeneous and impermeable unconsolidated set Largely permeable sediments with inter-bedded lenses of le Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated set Relatively homogeneous and impermeable unconsolidated set Largely permeable sediments with inter-bedded lenses of le Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments ower permeability material f higher permeability material ediments sediments sediments ower permeability material
<u></u>	Ground surface eleventh Aquifer Characterist Is more than 1 aquif	ics:		Unknown Jnknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3 15	- -
	_ Flow direction			_
	_ Horizontal hydraulic Vertical hydraulic gr			Unknown
	_K range (ft/day)	Measured low high	using: Slug Test Laboratory	Field data Unknown
	Transmissivity (ft2/d	lay): Measured low high	using: Slug Test Laboratory	
	Comments:			

Ther	rmal Treatment - Design								Facility ID#:	0840
<u>x</u>	Thermal treatment:		Conductive	·						
		F	Electrical I	Resistance						
		<u>x</u> S		_ 3 phase		_ 6 phase		_AC power	DC	power
		_		Steam		_ Steam + air		_Steam + O2	}	
	Time of Test		Other (desc		1- C					
<u>x</u>	Type of Test: Geology of Treatment Zone	Pilot te		_	scale Syster	n eous and perme	ooblo un	concolidator	Leadimente	
<u>x</u>	Geology of Treatment Zone	;.			_	ous and imper				
			<u>x</u>	_	ū	·			of lower perme	ability material
			^						·	neability material
						ured bedrock (i			3 - 1 -	,
						limestone, san		,		
<u>x</u>	Treatment Targe Zone:	s	Saturated		Vad		<u>x</u>	Both (Satura	ated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	Sep-00				Duratio	n: <u>3.5 y</u>	<u>rs</u>		
	Hydraulic Control		l'es	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				900			Unkn	own (x ft)
	Thickness of target zone (f				<u>20</u>			Unkn		
	Depth to top of target zone				<u>10</u>			Unkn		
	Thickness of target zone be		ter table	(ft):	-		_	Unkn		
	Number of energy delivery	-						Unkn		
	Number of extraction points	5.			-		_	Unkn	own	
	Temperature Profile:									
	Initial formation temperatur	e (deg C	C):						Unknown	
	Maximum representative for	rmation	tempera	ture (deg C):				Unknown	
	Time to reach maximum re	presenta	ative tem	perature (da	ays):				Unknown	
	Duration of treatment at rep	resenta	itive temp	erature (da	ays):				Unknown	
						<u>D</u>	oate		Temperatu	re (deg C)
	Formation temperature imm									
	Formation temperature pos			•	t 1:					
	Duration of post-treatment	monitori	ng (days):						
<u>x</u>	Mass of contaminant remove	ved:								
~		iquid pu	mpina:		5000 gal /	month		lb	kg	Unknown
		por stre			500000 gal	<u>.</u>		-	kg	Unknown
	Tota					· 			kg	Unknown
	Comments:									
	Attachments:									

Cost and Performance Facility ID#: 0840

Performance						
Remediation	Goal:					
	<u>x</u> In Groundw	ater:				
			0.1 ft of free	product or asym	ptotic removal rates of f	uel
	In Soil:					
Was the Ren	nediation Goal Achiev					
	Comn	nent: —				
		_				
	In Soil	_				
	Comn	nent: —				
		_				
General com	ments on the thermal	applica	ation:			
Energy	Hand.			kWhr	1.0.0/15/ 3	1.3.475 4 13
Total Energy				KWnr		_kWhr/yd ³
_	Total energy app	lied to ti	reatment zone:		kWhr/m ³	kWhr/yd
_	Other energy:				kWhr/m ³	kWhr/yd
		Please	note other energy:			
Cost						
Total Project	Cost:		10000000			
	Consultant Cost:		<u></u>			
_	Thermal Vendor	Coet:		=		
_		0051.	-	m³	yd³	
_	Energy Cost:		100000 /	"	yu	
<u>X</u>			1000000 / yr			
X			6000000			
_	Other Cost 3:			_		
<u>x</u> Please	note other cost:	<u>x</u>	Other Cost 1:		<u>O&M</u>	
		<u>X</u>	Other Cost 2:		Construction	
			Other Cost 3:			

<u>X</u>

<u>x</u>	File Analyzed By: JT	<u>x</u> PD			Date:	10/30/2006
	Type of treatment:	Conductive	Steam	x ERHOther:		
	Type of Contaminant:	Chlorinated Sol	vents	Petroleum Hydrocarbons	Pesticides	
		Wood Treating		Other:		
	Treatment Status:	<u>x</u> Active	Post			
	Type of Test:	Pilot Test	Full Scal	e System		
	Start of Test:		End	of Test:	Duration:	
	Type of Site:	Non-DOD	DoD			
<u>x</u>	Facility Name: Richmond	, VA				
	Address:					
	City, State, Zip Code:	Richmond, VA				
	OU# or Site #:					
<u>x</u>	Primary point of contact:	David Fleming				
-	Organization: TRS	<u>David Froming</u>				
	Address: 7421-A Warren	SE				
	City, State, Zip Code:	Snoqualmie, WA 9806	55			
	Phone #: 425-396-4266	•	email: dfle	eming@thermalrs.com		
<u>x</u>	Other contacts or vendors wh	no worked on site		None		
	Point of contact: Art	<u> Faddeo</u>				
	Type: <u>x</u> Vendor, C	onsultant	_ Vendor, Techn	ical ApplicationsO	ther	
	Organization: <u>ENSR</u>					
	Address:					
	City, State, Zip Code:					
	Phone #: 978-589-3095		email: ata	ddeo@ensr.com		
O	A/QC					
Q.	A/Q0					
	_ Characteristics of Interest					
	Good pre- and post-tre	atment groundwater dat	a	Good pre- and post-treatm	ent soil data	
	Good temperature prof	file vs. time information		Flux assessment		
	Groundwater elevation	as		Geologic cross-section		
	Hydraulic Conductivit	y information				

Facility ID#:

0845

General Site Information

(General Site Ass	sessment Data					Facility ID	D#: <u>0845</u>
-	Impacted 2	- "		Width (ft):	Thick	ness (ft):		Unknown
			s defined by documentation					
		Alternative method	od for determining size of im	pacted zone (See source zo	ne definition attachmen	ts)		
		Map attachment						
-	Monitor W	Vells: Number of relevant m	nonitoring wells with ground					None
				Pre-treatment:		Post-treatment:		
		Number of wells relati						
		Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
-	Soil Boring		il borings with pre-treatment					
			il borings with post-treatmer					
		Number inside treatme	ent zone:	Number outside	treatment zone:			
2	x Types of C	Contaminants					1	
					Average Pre-treatme	nt Concentration per	Average Post-treatme	ent Concentration per
					Chem		Chen	
۲		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	5 mg/L	None	None	None
		x Tetrachloroethene	Jet Fuel		50 mg/L	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
	Chaminala of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
	Comme	nts:						
				-				
	Attachmen	nts:						
							-	-

Нус	Irogeologic Conceptua	al Model		Facility ID#:	0845
<u>x</u>	Geology:	Zone	<u>Unconsolidated Sediments</u>		
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated	d sediments	
			x Relatively homogeneous and impermeable unconsolida	ted sediments	
			Largely permeable sediments with inter-bedded lenses	of lower permeability materia	al
			Largely impermeable sediments with inter-bedded layer	s of higher permeability mat	erial
			Competent, but fractured bedrock (i.e. crystalline rock)		
			Weathered bedrock, limestone, sandstone		
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated	d sediments	
			Relatively homogeneous and impermeable unconsolida	ted sediments	
			Largely permeable sediments with inter-bedded lenses		al
			 x Largely impermeable sediments with inter-bedded layer 		
			Competent, but fractured bedrock (i.e. crystalline rock)	3 - 1	
			Weathered bedrock, limestone, sandstone		
×	Aquifer Characterist Is more than 1 aquif Depth to water:		No Yes (number): Aquifer 1	_ Unknown (assume single aqu 3	uifer)
	_ Flow direction			_	
	_ Horizontal hydraulic	gradient (feet/foot):		Unknown	ı
	Vertical hydraulic gr	radient (feet/foot):		Unknown	ı
	_ K range (ft/day)	Measure	d using: Slug Test Laboratory	Field data	
		low		Unknown	ı
		high			
	Transmissivity (ft2/c	day): Measure	d using: Slug Test Laboratory	Field data	
		low		Unknown	ı
		high			

Comments:

The	rmal Treatment - Design							Fa	acility ID#:	0845
<u>x</u>	Thermal treatment:		_ Conductive	·						
		<u>x</u>	Electrical F	Resistance						
			Steam	_ 3 phase		_ 6 phase		AC power	DC	power
				Steam		_ Steam + air		Steam + O2		
	Torre of Tort	D.1	_ Other (desc		1.6.					
	Type of Test:				-scale Systen		مردد ملطم		- di	
<u>x</u>	Geology of Treatment Zor	ie.			_	ous and permea ous and imperm				
				-		ediments with in				shility material
			<u>x</u>						•	neability material
			_		•	ured bedrock (i.e		-	r nigher peni	icability material
						limestone, sand	-			
<u>x</u>	Treatment Targe Zone:					ose only		Both (Saturate	d and Vadose	zones)
_	_ Start of Thermal Test:			,		Duration		(
	_ Hydraulic Control		_ Yes	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				12040			Unknow	n (x ft)
	Thickness of target zone (ft):			<u>28</u>			Unknow	'n	
	Depth to top of target zone	e (ft bo	gs):		<u>2</u>			Unknow	'n	
	Thickness of target zone b	elow	water table ((ft):	<u>22</u>			Unknow	n	
	Number of energy delivery	/ point	is:		<u>60</u>			Unknow	n	
	Number of extraction poin	ts:			<u>60</u>			Unknow	n	
	_Temperature Profile:									
	_ remperature Frome. Initial formation temperatu	re (de	od C).						Unknown	
	Maximum representative f		- '	ture (dea C	:)·			_	Unknown	
	Time to reach maximum re		•						Unknown	
	Duration of treatment at re				• /				Unknown	
				(4.	,-,-					
						<u>Da</u>	te		Temperatur	re (deg C)
	Formation temperature im	media	tely post-tre	atment:						
	Formation temperature po	st-trea	atment moni	toring even	nt 1:					
	Duration of post-treatment	moni	toring (days)):						
	_ Mass of contaminant remo									
		•	pumping:						kg	Unknow
			stream:						kg	Unknow
	Tot	al:						_lb	kg	Unknow
	Comments:									
			_							
		electro	ode spacino	1						
	Attachments:									

Cost and Performance Facility ID#: 0845

Periormance						
Remediation Goal:						
<u>x</u>	In Groundwater:					
			PCE at 5 ug/l	L or 99.93% redu	<u>iction</u>	
	In Soil:					
Was the Remediation (
	In Groundwater					
	Comment: —					
						
	In Soil					
	Comment:					
General comments on	the thermal applicati	on:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	kWh	nr/vd ³
	energy applied to tre				kWhr/m³	
Other						kWhr/yo
outlet		ote other energy:			_ KVVIII/III	KWIII/y
	Flease III	ote other energy.				
Cost						
Total Project Cost:						
•	ultant Cost:					
·	nal Vendor Cost:					
	y Cost:			m³	_ yd³	
	Cost 1:				_ , .	
	Cost 1:	-				
Other		01. 0				
Please note othe	r cost:	Other Cost 1:				
		_ Other Cost 2:				
		Other Cost 3:				

File Analyzed By: PD ____ Date: 11/15/2006 Type of treatment: Conductive Steam ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: 12/17/2003 End of Test: 8/4/2004 Duration: 231 d Type of Site: ___Non-DOD DoD <u>X</u> Facility Name: Ft. Lewis, Washington Area 1 City, State, Zip Code: Ft. Lewis, Washington OU# or Site #: East Gate Disposal Yard NAPL Area 1 Primary point of contact: Travis Shaw Organization: Address: City, State, Zip Code: Phone #: 206-764-3527 email: travis.c.shaw@usace.army.mil Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0860

General Site Information

_ Impacted Zone: _ Monitor Wells:	Alternative met	ow direction)(ft.): as defined by documentation hod for determining size of im	Width (ft):				
Monitor Wells:	Alternative met	•		Thick	ness (ft):		Unknown
Monitor Wells:	Map attachmen	hod for determining size of im	1				
Monitor Wells:	Map attachmen	•	npacted zone (See source	zone definition attachmen	ts)		
Monitor Wells:	 ·	nt					
Monitor Wells:							
	Number of relevant	monitoring wells with grounds	water data:				None
		g g	Pre-treatmer	t: 35	Post-treatment:	<u>35</u>	
	Number of wells rela	ative to treatment zone:	7.70 1.00411101	<u>55</u>	Tool troutmont.	<u>55</u>	
	Pre-treatment		Upgradient: 3	Downgradient:	16 Cro	ssgradient: 4	
	Post-treatment	-	Upgradient: 3	Downgradient:		ssgradient: 4	
	r oot addanon	<u>12</u>	opgradiona <u>s</u>	20migradiona	<u>10</u>	<u>.</u>	
Soil Borings:	Number of relevant s	oil borings with pre-treatment	t data:				
Joil Bollings.		soil borings with post-treatmen					
	Number inside treatn	= :		de treatment zone:			
	Number inside treatif	ient zone	_ Number outs	de treatment zone.			
Turnes of Conton	sinonto						
Types of Contan	illiants	1					
				Average Pre-treatme		Average Post-treatm	
	CIL 1 . ICI	B. I. W. I.	0.1	Chem		Chen	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/l
	Trichloroethene	Hexane	Creosote	1 mg/L	None	0.05 mg/L	None
Г	Tetrachloroethene	Jet Fuel		0.001 mg/L	None	0.001 mg/L	None
F	1,1-dichloroethene	Napthalene		0.5 mg/L	None	0.01 mg/L	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene	<u> </u>	None	None	None	None
emicals of	1,1,1-trichloroethane	o-xylene		0.01 mg/L	None	0.001 mg/L	None
	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			0.005 mg/L	None	0.001 mg/L	None
	TCE - deep			0.01 mg/L	None	0.05 mg/L	None
	cis-1,2-DCE - deep			0.001 mg/L	None	0.001 mg/L	None
x	1,1,1-TCA - deep			0.001 mg/L	None	0.001 mg/L	None
				0.001 mg/L	None	0.001 mg/L	None
<u>x</u>	PCE - deep		1	0.001 mg/L	None	0.001 mg/L	
<u>x</u>	PCE - deep Vinyl chloride - deep					0.001 mg/L	None

Hyd	rogeologic Conceptua	al Model					Facility ID#	: <u>0860</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relatively Largely in Competer Weathere Relatively Relatively Largely in Competer	w homogeneous homo	sus and permeable sus and impermea diments with inter- sediments with inter- sed bedrock (i.e. c mestone, sandsto sus and permeable sus and impermea diments with inter-	ne a unconsolidated se ble unconsolidated bedded lenses of lo er-bedded layers of rystalline rock)	sediments ower permeabili higher permea diments sediments ower permeabili	bility material
<u>x</u>		vation based on wells in o				ft amsl		Unknown
<u>x</u>	Aquifer Characteris							
	Is more than 1 aqui	fer present?	No	Yes (num	ber):		nknown (assume	single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 11		Aquifer 2	Aquifer 3	-	
<u>x</u>	Flow direction		SW		<u></u>		-	
<u>x</u>	Horizontal hydraulic Vertical hydraulic gr	c gradient (feet/foot):	0.001				- <u> </u>	Unknown Unknown
	_ K range (ft/day)	Measured low high	using:	_ Slug Test	Labor		Field data	Unknown
	Transmissivity (ft2/d	day): Measured low high	using:	_ Slug Test	·	atory	Field data	Unknown
	Comments:							

The	rmal Treatment - Design					Facility ID#:	<u>0860</u>
<u>x</u>	Thermal treatment:	Conductive					
		<u>x</u> Electrical Resi	stance				
			phase	6 phase	AC pow	er DC	power
		Steam	eam	Steam + air	Steam ±	02	
		Other (describ		Steam + an	Steam +	02	
~	Type of Test:	Other (describe	-	am			
X	Geology of Treatment Zon		-	neous and permea	able unconsolida	ated sediments	
<u>X</u>	Geology of Treatment Zon		, ,	neous and imperm			
				sediments with int			ability material
				le sediments with		•	-
				ctured bedrock (i.e			neability material
		·	·	k, limestone, sand	-	,	
<u>x</u>	Treatment Targe Zone:	Saturated on				aturated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	12/17/2003	v	•	231 day	nurated and vadose	Zones)
<u>x</u>	Hydraulic Control	<u> </u>	No	Buration	. <u>251 day</u>		
^	Trydradilo Control	<u>x</u> 103 _	110				
<u>x</u>	Treatment Cell Design:						
_	Size of target zone (ft2):		25400		U	nknown (_ x ft)
	Thickness of target zone (f	t):	36		<u></u>	nknown	′
	Depth to top of target zone		2			nknown	
	Thickness of target zone b				U:	nknown	
	Number of energy delivery		106		U:	nknown	
	Number of extraction point		106		U:	nknown	
<u>x</u>	Temperature Profile:						
	Initial formation temperatur	re (deg C):		<u>22</u>		Unknown	1
	Maximum representative for	ormation temperature	e (deg C):	<u>56</u>		Unknown	1
	Time to reach maximum re	epresentative temper	ature (days):	<u>161</u>		Unknown	1
	Duration of treatment at re	presentative tempera	ature (days):	<u>70</u>		Unknown	1
				Da	te	Temperatu	ire (dea C)
	Formation temperature imr	mediately post-treatn	nent:				
	Formation temperature pos	st-treatment monitori	ng event 1:				
	Duration of post-treatment	monitoring (days):					
<u>x</u>	Mass of contaminant remo	wed:					
-		liquid pumping:	2.0785		lb	<u>x</u> kg	Unknow
		apor stream:	43152		lb	<u>-</u> kg	Unknow
	Tota	•	43154		lb	<u>-</u> &	Unknow
					· 		
	Comments:						
	Total vol	ume - 30900 yd3					
	Attachments:	ume - 30300 yu3					
	, maorimonio.						

Cost	t and Performance					Facility ID#:	0860
	_ Performance						
	Remediation Goal:						
		- In Groundwater: -					
		 In Soil:					
		· · · · · · · · · · · · · · · · · · ·					
	Was the Remediatio	n Goal Achieved:					
		_ In Groundwater _					
		Comment: -					
		_					
		_ In Soil					
		Comment: -					
		_					
	Canaral sammanta	on the thermal applie	ation.				
	General comments of	on the thermal applica	ation:				
	Target temps -	100C in saturated ze	one and 90C in vados	se zone, then tempe	rature specifics wi	II be maintained	for 60 days
	Lessana Learnad						
	Lessons Learned						
v	Energy						
<u>x</u>		92970	50	V l-W/hm	kWhr/m ³	kW	br/ud ³
	Total Energy Used:	·		× kWhr			
			reatment zone:	7913000 kWhr	·	_ kWhr/m ³	
	Oth	ner energy:				_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:	-			
	_ Cost						
	Total Project Cost:						
	•	nsultant Cost:					
	· 	ermal Vendor Cost:					
					m^3	3	
		ergy Cost:			m°	_ yd³	
	·	ner Cost 1:					
	· · · · · · · · · · · · · · · · · · ·	ner Cost 2:					
	Oth	ner Cost 3:					
	Please note of	her cost:	Other Cost 1:				
		_	Other Cost 2:				
		_	Other Cost 3:				

General Site Information Facility ID#: 0863 File Analyzed By: PD ____ Date: 11/15/2006 Type of treatment: Conductive ____ Steam ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _ Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: 2/14/2005 End of Test: 8/5/2005 Duration: 172 day Type of Site: ____Non-DOD DoD Facility Name: Ft. Lewis, Washington Area 2 Address: City, State, Zip Code: Ft. Lewis, Washington OU# or Site #: East Gate Disposal Yard NAPL Area 2 Primary point of contact: Travis Shaw Organization: Address: City, State, Zip Code: Phone #: 206-764-3527 email: travis.c.shaw@usace.army.mil Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment

_ Geologic cross-section

____ Groundwater elevations

Genera	al Site Ass	sessment Data					Facility I	D#: <u>0863</u>
<u>x</u> Ir	mpacted 2	Impacted zone a	s defined by documentation	Width (ft):		tness (ft): <u>varies/up</u>	to 52	Unknown
		Map attachment		pacied zone (See Source zo	one definition attachine	its)		
<u>x</u> 1	Monitor W	/ells: Number of relevant m	nonitoring wells with grounds	water data:				None
				Pre-treatment:	<u>22</u>	Post-treatment:	<u>22</u>	
		Number of wells relati	ive to treatment zone:					
		Pre-treatment	In: <u>13</u>	Upgradient: 1	Downgradient:	<u>6</u> Cro	ssgradient: 2	
		Post-treatment	In: <u>13</u>	Upgradient: 1	Downgradient:	<u>6</u> Cro	ssgradient: 2	
<u>x</u> S	oil Boring		il borings with pre-treatment					
			il borings with post-treatmer					
		Number inside treatme	ent zone: 12	Number outside	e treatment zone:	<u>0</u>		
_								
<u>x</u> T	ypes of C	ontaminants						
						ent Concentration per nical:		nent Concentration per mical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		x Trichloroethene	Hexane	Creosote	5 mg/L	100 mg/kg	0.1 mg/L	0.1 mg/kg
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		x cis-1,2-dichloroethene	Benzene		0.5 mg/L	1 mg/kg	0.01 mg/L	0.01 mg/kg
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
Chem	nicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	ncern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
<u> </u>					None	None	None	None
	Commer	nte:						
	Comme							
Α	ttachmen	ts:						

Hyd	rogeologic Conceptu	al Model		Facility ID#: 0863
Hyd	lrogeologic Conceptu	al Model Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated s Relatively homogeneous and impermeable unconsolidated s Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated s Relatively homogeneous and impermeable unconsolidated s Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock)	ediments d sediments lower permeability material of higher permeability material ediments d sediments lower permeability material
<u>x</u>	Ground surface ele Aquifer Characteris Is more than 1 aqu Depth to water:	stics: ifer present? <u>x</u> low value (ft bgs): high value (ft bgs):	Weathered bedrock, limestone, sandstone or adjacent to treatment zone: 278 ft amsl No Yes (number):	Unknown Unknown (assume single aquifer)
<u>x</u>	Flow direction	Unknown:	<u>sw</u>	-
<u>x</u>	Horizontal hydraulic	c gradient (feet/foot): radient (feet/foot):	0.001 to 0.004	Unknown
<u>x</u>	K range (ft/day)	Measured low high	d using: x Slug Test x Laboratory y 24.2	≤ Field data Unknown
	Transmissivity (ft2/	low high		Field data Unknown
	Comments: b	Shallow aquifer only is ut it is not believed to b APL.	affected by NAPL. There is a deeper aquifer separated by a e impacted by	glacial till & lacustrine silt unit

The	rmal Treatment - Design					Facility ID#:	<u>0863</u>
<u>x</u>	Thermal treatment:	Conductive					
		x Electrical Resistance					
		3 phase Steam		6 phase	AC power	DC	power
		Steam		_ Steam + air	Steam + O	2	
		Other (describe)					
<u>X</u>	Type of Test:		l-scale Systen				
<u>X</u>	Geology of Treatment Zone		-	•	ble unconsolidate		
			-	•	eable unconsolida		
		_			er-bedded lenses	·	•
					inter-bedded layer	rs of higher perr	neability material
					. crystalline rock)		
				limestone, sands			
<u>X</u>	Treatment Targe Zone:	Saturated only	Vade	-		rated and Vadose	zones)
<u>X</u>	Start of Thermal Test:	<u>2/14/2005</u>		Duration:	172 day		
<u>x</u>	Hydraulic Control	<u>x</u> YesNo					
<u>x</u>	Treatment Cell Design:						
	Size of target zone (ft2):		22390		Unk	nown (x ft)
	Thickness of target zone (ft	(t):	<u>52</u>		Unki	nown	
	Depth to top of target zone	(ft bgs):	<u>2</u>		Unki	nown	
	Thickness of target zone be	elow water table (ft):	<u>42</u>		Unk	nown	
	Number of energy delivery	points:	<u>101</u>		Unki	nown	
	Number of extraction points	S:	<u>56</u>		Unki	nown	
<u>x</u>	Temperature Profile:						
	Initial formation temperature	re (deg C):		<u>17</u>		Unknown	ı
	Maximum representative fo	ormation temperature (deg 0	C):	<u>85</u>		Unknown	ı
	Time to reach maximum rep	presentative temperature (days):	<u>152</u>		Unknown	ı
	Duration of treatment at rep	presentative temperature (d	ays):	<u>30</u>		Unknown	I
				<u>Dat</u>	<u>e</u>	Temperatu	re (deg C)
	Formation temperature imm	nediately post-treatment:					
	Formation temperature pos	_	nt 1:	-			
	Duration of post-treatment	monitoring (days):					
<u>x</u>	Mass of contaminant remov	ved:					
	Via I	liquid pumping:	13.82	<u>16</u>	lb	<u>x</u> kg	Unknown
	In va	apor stream:	1340	<u>)</u>	lb	<u>x</u> kg	Unknown
	Tota	al:	1402	<u>5</u>	lb	<u>x</u> kg	Unknown
	Comments: 1089 kg -	- TCE, 245 kg - cis-1,2-[OCE, 1133	7 kg - TPH = 12	2671 kg		
	Attachments:						
	, madrimonds.						

Y Performance Remediation Goal: X In Groundwater: Remove CVOCs to maximum extent practicable (No strict numer)	
Remediation Goal: <u>x</u> In Groundwater:	
x In Groundwater:	
-	
	rical goal)
x In Soil:	
Same as above	
Was the Remediation Goal Achieved:	
<u>x</u> In Groundwater	
Comment:	
<u>Yes</u>	
<u>x</u> In Soil	
Comment:	
<u>Yes</u>	
General comments on the thermal application:	
Constant Continue on the mornial application.	
Performance goals: 100C in saturated zone, 90C in vadose zone, and keep temperature at these for 7 days.	
Lessons Learned	
Performance goals of 100/90-deg C within treatment zone were not achieved although remedy goal still achie	ved: restate
Performance goals of 100/90-deg C within treatment zone were not achieved although remedy goal still achie performance goal requirements in contract	ved; restate
performance goal requirements in contract	ved; restate
performance goal requirements in contract <u>x</u> Energy	
<u>x</u> Energy Total Energy Used: 9.547,000 <u>x</u> kWhr <u>kWhr/m³</u> kWhr/m³	Nhr/yd ³
<u>x</u> Energy Total Energy Used: 9,547,000	Whr/yd ³ kWhr/yd ³
x Energy Total Energy Used: 9,547,000 x kWhr kWhr/m³ kWhr/m³ x Total energy applied to treatment zone: 9,181,000 kwhr kWhr/m³ Other energy: kWhr/m³	Whr/yd ³ kWhr/yd ³
<u>x</u> Energy Total Energy Used: 9,547,000	Whr/yd ³ kWhr/yd ³
x Energy Total Energy Used: 9,547,000 x kWhr kWhr/m³ kWhr/m³ x Total energy applied to treatment zone: 9,181,000 kwhr kWhr/m³ Other energy: kWhr/m³	Whr/yd ³ kWhr/yd ³
<u>x</u> Energy Total Energy Used: 9,547,000 <u>x</u> kWhr <u>kWhr/m³ kWhr/m³ kWhr/m³ kWhr/m³ kWhr/m³ kWhr/m³ kWhr/m³ kWhr/m³ kWhr/m³ Mark whr/m³ which is a second control of the energy: Cost</u>	Whr/yd ³ kWhr/yd ³
<u>x</u> Energy Total Energy Used: 9,547,000 <u>x</u> kWhr <u>kWhr/m³ _kN</u> <u>x</u> Total energy applied to treatment zone: 9,181,000 kwhr _kWhr/m³ Other energy:kWhr/m³	Whr/yd ³ kWhr/yd ³
Energy Total Energy Used: 9,547,000	Whr/yd ³ kWhr/yd ³
Energy Total Energy Used: 9,547,000 x kWhr kWhr/m³ kWhr/m³ X Total energy applied to treatment zone: 9,181,000 kwhr kWhr/m³ Other energy: kWhr/m³ Please note other energy: Cost Total Project Cost: Total Project Cost: Thermal Vendor Cost:	Whr/yd ³ kWhr/yd ³
Energy Total Energy Used: 9.547,000	Whr/yd ³ kWhr/yd ³
Energy Total Energy Used: 9,547,000	Whr/yd ³ kWhr/yd ³
Energy Total Energy Used: 9.547,000	Whr/yd ³ kWhr/yd ³
performance goal requirements in contract X Energy Total Energy Used: 9.547,000	Whr/yd ³ kWhr/yd ³
Energy Total Energy Used: 9.547,000	Whr/yd ³ kWhr/yd ³

General Site Information Facility ID#: 0865 File Analyzed By: PD ____ Date: 11/15/2006 Type of treatment: Conductive ___ Steam ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: ___ Active Post Type of Test: ___ Pilot Test Full Scale System Start of Test: 10/10/2006 End of Test: 1/26/2007 Duration: 108 days Type of Site: ___Non-DOD DoD <u>X</u> Facility Name: Ft. Lewis, Washington Area 3 City, State, Zip Code: Ft. Lewis, Washington OU# or Site #: East Gate Disposal Yard NAPL Area 3 Primary point of contact: Kira Lynch Organization: Address: City, State, Zip Code: Phone #: 206-764-6918 email: kira.p.lynch@nws02.usace.army.mil Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___Flux assessment

_ Geologic cross-section

____ Groundwater elevations

General Site A	ssessment Data					Facility II	D#: <u>0865</u>
Impacted	- "	v direction)(ft.): s defined by documentation	Width (ft):	Thickr	ness (ft):		Unknown
	 :	•	pacted zone (See source zo	one definition attachmen	te)		
	Alternative metric	od for determining size of in	ipacied zone (See Source zo	one definition attachmen	is)		
	wap attacriment						
x Monitor	Walle: Number of relevant m	nonitoring wells with grounds	water data:				None
<u>x</u> Monitor	vveils. Number of relevant in	ionitoring wells with grounds	Pre-treatment:	30	Post-treatment:	<u>39</u>	None
	Number of wells relati	ive to treatment zone:	Fie-tieatilient.	39	rost-treatment.	<u>39</u>	
	Pre-treatment	In: 13	Upgradient: 9	Downgradient:	8 Cros	ssgradient: 9	
	Post-treatment	In: <u>13</u>	Upgradient: 9	Downgradient:	_	ssgradient: 9	
	i ost troutiont	III. <u>15</u>	opgradient. <u>2</u>	Downgradient.	<u> </u>	ogradient. <u>2</u>	
Soil Borir	nas: Number of relevant so	il borings with pre-treatment	data:				
	=	il borings with post-treatmer					
	Number inside treatme			e treatment zone:			
			_				
x Types of	Contaminants						
				Average Pre-treatme			ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	None	None	None	None
	<u>x</u> Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	x cis-1,2-dichloroethene	Benzene		None	None	None	None
	x trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane	x 135-trimethylbenzene		None	None	None	None
Concom	1,1,2,2-tetrachloroethane	x 124-trimethylbenzene		None	None	None	None
	<u>x</u> Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comm	ents:						
				-	_		
Attachme	ents:						
	-						

Hyd	rogeologic Conceptu	al Model		Facility ID#: 0865
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidate Relatively homogeneous and impermeable unconsolidate Largely permeable sediments with inter-bedded lenses Largely impermeable sediments with inter-bedded laye Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidate Relatively homogeneous and impermeable unconsolidate Largely permeable sediments with inter-bedded lenses Largely impermeable sediments with inter-bedded laye Competent, but fractured bedrock (i.e. crystalline rock)	ated sediments s of lower permeability material ed sediments ated sediments ated sediments s of lower permeability material ers of higher permeability material ers of higher permeability material
<u>×</u>	Ground surface ele Aquifer Characteris Is more than 1 aqui Depth to water:	stics:		Unknown Unknown (assume single aquifer)
<u>x</u>	Flow direction _ Horizontal hydraulic	Unknown: c gradient (feet/foot):	NW	Unknown
	Vertical hydraulic g _ K range (ft/day)	radient (feet/foot): Measured low high	Ising: Slug Test Laboratory	Unknown Field data Unknown
	Transmissivity (ft2/s	day): Measured low high	Ising: Slug Test Laboratory	Field data Unknown

The	ermal Treatment - Design								Facility	ID#:	<u>0865</u>
<u>x</u>	Thermal treatment:		_ Condu	ctive							
		<u>x</u>	Electri	cal Resistance							
			-	3 phase		6 phase	_	AC power		DC	power
			_ Steam	-							
			-	Steam		Steam + air		Steam + O2	2		
				(describe)							
<u>X</u>	Type of Test:	_ Pilot	test	_	ll-scale Sy						
<u>X</u>	Geology of Treatment Zone	e:				jeneous and per					
			-		-	eneous and imp					
			2			le sediments with					-
			-		-			-	s of nign	er pern	neability material
			•			ractured bedrock ock, limestone, sa					
v	Treatment Targe Zone:		Satura					Both (Satur	entad and V	Jadosa	zonos)
<u>x</u>	Treatment Targe Zone: Start of Thermal Test:		_ Satura 0/2006	ated only		Vadose only	<u>X</u> tion: <u>108</u>		ateu anu	v adose	zones)
<u>x</u>	Hydraulic Control	<u>X</u>	Yes	No		Dula	1001. 100	<u>s uays</u>			
~	riyaraano oonaoi	^	103	110							
<u>x</u>	Treatment Cell Design:										
_	Size of target zone (ft2):				18200			Unkı	nown	(_ x ft)
	Thickness of target zone (f	t):			30			Unkr	nown		
	Depth to top of target zone	(ft bg	js):		<u>0</u>			Unkr	nown		
	Thickness of target zone b	elow v	water ta	ble (ft):	21			Unkr	nown		
	Number of energy delivery	point	s:		<u>93</u>			Unkr	nown		
	Number of extraction points	s:			<u>93</u>			Unkr	nown		
<u>x</u>	Temperature Profile:										
	Initial formation temperatur	e (de	g C):			<u>13</u>			Ur	ıknown	
	Maximum representative for	ormati	on temp	erature (deg	C):	<u>89</u>			Ur	nknown	
	Time to reach maximum re	prese	entative	temperature (days):	<u>38</u>			Ur	nknown	
	Duration of treatment at re	prese	ntative t	emperature (c	days):	<u>13</u>			Ur	ıknown	
							<u>Date</u>		Tem	peratui	re (deg C)
	Formation temperature imr	nedia	tely pos	t-treatment:		1/27/2007			<u>68</u>		
	Formation temperature pos	st-trea	itment n	nonitoring eve	nt 1:	4/9/2007			<u>39</u>		
	Duration of post-treatment	monit	toring (d	ays):		<u>186+</u>					
<u>x</u>	Mass of contaminant remo	ved:									
		-	pumpin	g:			_	lb	<u>x</u> kg		Unknown
			stream:	_				lb	<u>x</u> kg		Unknown
	Tota	al:						lb	<u>x</u> kg		Unknown
	Comments:										
	Australia										
	Attachments:										
						-					

t and Performance					Facility ID#:	<u>0865</u>
_ Performance						
Remediation Goal:						
	In Groundwater: —					
	<u> </u>					
	In Soil:					
Was the Remediation						
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m		Vhr/yd ³
To:	tal energy applied to to	reatment zone:			kWhr/m ³	kWhr/yd
Oth	ner energy:				kWhr/m ³	kWhr/yd
	Please	note other energy:				
Cost						
Total Project Cost:						
Co	nsultant Cost:	<u></u>				
The	ermal Vendor Cost:					
En	ergy Cost:			m ³	yd³	
Oth	ner Cost 1:					
Oth	ner Cost 2:					
Oth	ner Cost 3:	-				
Please note of	ther cost:	Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

File Analyzed By: PD ____ Date: 10/30/2006 ____Other: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: 5/24/2004 End of Test: ongoing Duration: _____ Type of Site: Non-DOD __ DoD Facility Name: <u>Lake River Industrial Site</u> City, State, Zip Code: Ridgefield, WA OU# or Site #: _ Primary point of contact: Steve Taylor Organization: Address: City, State, Zip Code: Phone #: email: ____ Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0870

General Site Information

___ Hydraulic Conductivity information

(General Site Assessment Data Facility ID#: 0870													
2	Impacted 2	= "	ness (ft):		Unknown									
			as defined by documentation											
				npacted zone (See source zo	ne definition attachment	ts)								
		Map attachment												
-	Monitor W	vells: Number of relevant m	nonitoring wells with ground					None						
				Pre-treatment:		Post-treatment:								
			ive to treatment zone:	He was dispute	D	0								
		Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:							
		Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:							
_	Soil Borings: Number of relevant soil borings with pre-treatment data: Number of relevant soil borings with post-treatment data:													
		Number of relevant so	il borings with post-treatmen	nt data:										
		Number inside treatme	ent zone:	Number outside	treatment zone:									
2	Types of C	Contaminants												
					Average Pre-treatmer		Average Post-treatm Chen	ent Concentration per nical:						
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)						
		Trichloroethene	Hexane	x <u>Creosote</u>	None	None	None	None						
		Tetrachloroethene	Jet Fuel	x PCP	None	None	None	None						
		1,1-dichloroethene	Napthalene		None	None	None	None						
		cis-1,2-dichloroethene	Benzene		None	None	None	None						
		trans-1,2-dichloroethene	Tolune		None	None	None	None						
		1,1-dichloroethane	Ethylbenzene		None	None	None	None						
		1,2-dichloroethane	m/p-xylene		None	None	None	None						
		1,1,1-trichloroethane	o-xylene		None	None	None	None						
	Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None						
		1,1,2,2-tetrachloroethane			None	None	None	None						
		Vinyl Chloride			None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
					None	None	None	None						
	Comme	nts:												
			Impacted area	a of 4 acres and may conta	in 100,000 gallons of	wood-treating chem	<u>cials</u>							
	Attachmen	its:												
		<u> </u>			· · · · · · · · · · · · · · · · · · ·									

Hydrogeologic Conceptua	I Model		Facility ID#: 0870
Hydrogeologic Conceptua Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lot Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lot Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock)	ediments sediments ower permeability material f higher permeability material ediments sediments sediments ower permeability material
Ground surface elev Aquifer Characteristi	ics:	Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl No Yes (number): U Aquifer 1 Aquifer 2 Aquifer 3	Unknown inknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:		- - -
Flow direction			-
Horizontal hydraulic Vertical hydraulic gra			Unknown
K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data
Transmissivity (ft2/da	high	using:Slug TestLaboratory	Field data Unknown
Comments:			
Attachments:			

The	rmal Treatment - Design					Facility ID#: 08	<u>870</u>
<u>x</u>	Thermal treatment:	Conductive					
		Electrical R	esistance				
			3 phase	6 phase	AC power	DC pow	ver
		x Steam	Phase I				
			Steam	Steam + air	Steam + O2	:	
		Other (desc	ribe)				
<u>x</u>	Type of Test:	Pilot test	<u>x</u> Full-scal	e System			
	Geology of Treatment Zon	e:	Relatively hor	mogeneous and perme	eable unconsolidated	d sediments	
			Relatively hor	mogeneous and imper	meable unconsolida	ted sediments	
			Largely permo	eable sediments with i	nter-bedded lenses	of lower permeabilit	y material
			Largely imper	meable sediments wit	h inter-bedded layer	s of higher permeat	oility material
			Competent, b	ut fractured bedrock (i	.e. crystalline rock)		
			Weathered be	edrock, limestone, san	dstone		
-	_Treatment Targe Zone:	Saturated	only	Vadose only	Both (Satur	ated and Vadose zone	es)
	_Start of Thermal Test:			Duratio	n:		
	_ Hydraulic Control	Yes	No				
_	_Treatment Cell Design:						
	Size of target zone (ft2):		_		Unkn	· —	x ft)
	Thickness of target zone (f		_		Unkn		
	Depth to top of target zone				Unkn		
	Thickness of target zone b				Unkn		
	Number of energy delivery		<u>6</u>		Unkn		
	Number of extraction point	S:	<u>17</u>		Unkn	own	
	_ Temperature Profile:						
	Initial formation temperatur	re (ded C):				Unknown	
	Maximum representative for		ure (dea C):			Unknown	
	Time to reach maximum re	·				Unknown	
	Duration of treatment at re					Unknown	
		,					
				D	ate	Temperature (d	leg C)
	Formation temperature imr	mediately post-trea	atment:				
	Formation temperature pos	st-treatment monit	oring event 1:				
	Duration of post-treatment	monitoring (days)	:				
	_ Mass of contaminant remo	ved:					
	Via	liquid pumping:			lb	kg	Unknown
	In va	apor stream:			lb	kg	Unknown
	Tota	al:			lb	kg	Unknown
	Comments:						
	Attachments:						

st and Performance					Facility ID#:	<u>0870</u>
_ Performance						
Remediation Goal:	_					
lı	n Groundwater: -					
lı	n Soil:					
Was the Remediation G						
lı	n Groundwater _					
	Comment: -					
	_					
lı	n Soil					
	Comment: -					
	_					
General comments on t	he thermal applica	ation:				
Lessons Learned						
-						
F						
Energy			1 777		1.14	NII / 13
Total Energy Used:			kWhr			
	energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/y
Other					_ kWhr/m ³	kWhr/y
	Please	note other energy:				
Cost						
Total Project Cost:						
-	ltant Casti					
· 	Itant Cost:					
' <u></u> '	al Vendor Cost:			3	3	
Energy					_ yd ³	
Other						
Other	Cost 2:					
Other	Cost 3:					
Please note other	cost:	Other Cost 1:				
		Other Cost 2:				

_ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD			Date:
_	Type of treatment:		x Steam	ERH Other:	
	Type of Contaminant:	Chlorinated Solver		Petroleum Hydrocarbons	Pesticides
	Type of Contaminant.	Wood Treating	iits <u>A</u>	Other:	r esticides
	Treatment Status:		x Post	_ Other.	
	Type of Test:	x Pilot Test	Full Scale	System	
	Start of Test:	Jul-96		of Test: <u>Jun-97</u>	Duration: 9 months
	Type of Site:		<u>x</u> DoD	52 1660 <u>640. 57</u>	Zumioni <u>z momin</u>
v	Eccility Names - Bromorton	Nevel Compley, Puget Se	ound Naval Shin	word (Pilot)	
<u>X</u>	Facility Name: <u>Bremertor</u> Address:	n Naval Complex: Puget So	Duliu Navai Silip	yaid (Filot)	
		Washington			
	City, State, Zip Code: OU# or Site #: OU C	Washington			
	00# 01 Site #. <u>00 C</u>				
<u>x</u>	Primary point of contact:	Brad Gross			
^	Organization: Navy	<u>Diad Gioss</u>			
	Address:				
		Washington			
	City, State, Zip Code:	Washington	:1		
	Phone #: <u>360-396-0028</u>		eman: <u>r.gr</u>	oss@navy.mil	
<u>x</u>	Other contacts or vendors w	ho worked on site		None	
	Point of contact: Cinc	dy O'Hare			
	Type:Vendor, C	Consultant	Vendor, Technic	cal Applications <u>x</u> Ot	ther
	Organization: Navy				
	Address: Engineering Fie	ld Acitivity Northwest; Na	val Facilities En	gineering Command; 19917 7th A	venue NE
	City, State, Zip Code:	Poulsbo, WA 98370			
	Phone #: <u>360-396-0014</u>		email: cinc	y.o'hare@navy.mil	
Q.	A/QC				
	•				
	_ Characteristics of Interest				
	Good pre- and post-tre	eatment groundwater data		Good pre- and post-treatme	ent soil data
	Good temperature pro	file vs. time information		Flux assessment	
	Groundwater elevation			Geologic cross-section	
				-	

0880

General Site Information

<u>x</u> Impacted	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u> Unknown
	Impacted zone a	as defined by documentation	1				
	Alternative meth	od for determining size of in	npacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor V	Vells: Number of relevant m	nonitoring wells with ground	water data:				None
			Pre-treatment:		Post-treatment:		
	Number of wells relat	ive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Boring	gs: Number of relevant so	il borings with pre-treatmen	t data:				
	Number of relevant so	il borings with post-treatmen	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
x Types of C	Contaminants						
					ent Concentration per		nent Concentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Chen Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	mical: Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene	<u>x No. 6 Fuel Oil</u> <u>x Diesel</u>	None	None	None	None
	cis-1,2-dichloroethene	Benzene	<u>x</u> <u>Diesei</u>	None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene			_		
	1,2-dichloroethane	-		None	None	None	None
	1,1,1-trichloroethane	m/p-xylene		None	None	None	None
Chemicals of		o-xylene			None		
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	nts:						
Attachmer	nts:						
	-						
	-						

0880

General Site Assessment Data

Hyd	rogeologic Conceptual	Model		Facility ID#: 0880
X	Geology:	Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated and sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers. Competent, but fractured bedrock (i.e. crystalline rock). Weathered bedrock, limestone, sandstone. Relatively homogeneous and permeable unconsolidated and sediments with inter-bedded layers. Cargely impermeable sediments with inter-bedded lenses of Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers. Competent, but fractured bedrock (i.e. crystalline rock). Weathered bedrock, limestone, sandstone	d sediments lower permeability material of higher permeability material sediments d sediments lower permeability material
<u>x</u>	Ground surface eleva	ation based on wells in or	adjacent to treatment zone: <u>~35</u> ft amsl	Unknown
X	Aquifer Characteristic Is more than 1 aquife Depth to water:	r present?	No Yes (number): X Aquifer 1 Aquifer 2 Aquifer 3 100	Unknown (assume single aquifer)
<u>x</u>	Flow direction		SE	_
<u>x</u>	Horizontal hydraulic g Vertical hydraulic grad	,		<u>X</u> Unknown <u>X</u> Unknown
<u>x</u>	K range (ft/day) Transmissivity (ft2/da	Measured of low high y): Measured of low		Field data X Unknown Field data X Unknown
	Comments:	high		

The	rmal Treatment - Design									F	acility ID#:	!	0880	
<u>x</u>	Thermal treatment:		_ Conducti	ve										
			_ Electrical	l Resistance										
				3 phase		6 phase		A	C pov	wer	I	OC po	wer	
		<u>x</u>	Steam											
			_	Steam		Steam +	air	S	team -	+ O2				
			Other (de	escribe)										
<u>x</u>	Type of Test: <u>x</u>	Pilot	t test	Full		•								
<u>x</u>	Geology of Treatment Zone	e:	_			geneous and p								
			_		,	geneous and i	•							
			<u>X</u>			ble sediments					-		-	
			_			eable sedimen					of higher pe	ermea	ability	material
			· · · · · · · · · · · · · · · · · · ·			fractured bedr		-	ne ro	ck)				
						rock, limestone								
<u>X</u>	Treatment Targe Zone:		_ Saturate	ed only		_ Vadose only		_		Saturate	d and Vado	se zoi	nes)	
<u>X</u>	Start of Thermal Test:	Jul-9				Du	uration:	9 montl	<u>18</u>					
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No										
<u>x</u>	Treatment Cell Design:													
_	Size of target zone (ft2):							<u>x</u>	ι	Jnknov	n (х	ft)
	Thickness of target zone (fi	t):						x		Jnknow	n ·			
	Depth to top of target zone	•	as):		50					Jnknow	n .			
	Thickness of target zone be			e (ft):	10					Jnknow				
	Number of energy delivery			,	8					Jnknow				
	Number of extraction points				3			_	t	Jnknow	n .			
<u>x</u>	Temperature Profile:													
	Initial formation temperatur	e (de	g C):						_	<u>x</u>	Unkno	wn		
	Maximum representative for	rmati	ion temper	rature (deg C	C):				_	<u>x</u>	Unkno	wn		
	Time to reach maximum re	prese	entative ter	mperature (d	lays):	-			_	<u>x</u>	Unkno	wn		
	Duration of treatment at rep	orese	ntative ten	nperature (da	ays):				_	<u>X</u>	Unkno	wn		
							Date				Tempera	iture ('dea (?)
	Formation temperature imm	nedia	tely post-t	reatment:			Date	<u> </u>	_	_	Tompore	ituro (uog .	<u> </u>
	Formation temperature pos	t-trea	atment mo	nitoring even	nt 1:				_	_				
	Duration of post-treatment	monit	toring (day	rs):						_				
<u>x</u>	Mass of contaminant remov							.,			,			** 1
		-	pumping:	_			_	11		_	kg		<u>x</u>	Unknow
			stream:		2	5 000 - 1	_	11		_	kg	•	<u>x</u>	Unknow
	Tota	11.			<u>3</u>	5,000 gal		11)	_	kg	-		Unknow
	Comments:													
	The extra	ction	and inje	ction wells v	were a	t depths of 50), 80 an	d 110 f	eet.					
	Attachments:													

Cost and Performance					Facility ID#:	0880
Performance						
Remediation Goal:						
	n Groundwater: —					
						-
ı	n Soil:					
Was the Remediation C	Soal Achieved:					
I	n Groundwater					
	Comment: —					
	_					
1	n Soil					
	Comment: —					
	_					
General comments on	the thermal applica	tion:				
System was eyna	nded in August 19	97				
Oystem was expa	indea in August 15	<u>01</u>				
Lessons Learned						
cost during 1st ni	ne months = \$61/ye	<u>d3</u>				
Energy				,		
Total Energy Used:			kWhr	<u></u>		
Total e	energy applied to tr	eatment zone:			kWhr/m ³	kWhr/yd ³
Other	energy:	_			kWhr/m ³	kWhr/yd ³
	Please	note other energy:				
Cost						
Total Project Cost:						
	Iltant Cost:					
	al Vendor Cost:					
·		-		m³	yd ³	
Energ				_'''	yu	
·	Cost 1:					
·	Cost 2:					
·	Cost 3:					
Please note other	cost:	Other Cost 1:				
	_	Other Cost 2:				
		Other Cost 3:				

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:
	Type of treatment:	Conductive	<u>x</u>	Steam	ERH	Other:	
	Type of Contaminant:	Chlorinated Sol	vents	<u>x</u>	Petroleum Hydro	ocarbons	Pesticides
		Wood Treating			Other:		
	Treatment Status:	Active	<u>X</u>	Post			
	Type of Test:	Pilot Test	<u>X</u>	Full Scale	e System		
	Start of Test:	<u>Aug-97</u>		End	of Test: Sep-99		Duration: 2 years 1 month
	Type of Site:	Non-DOD	<u>x</u>	DoD			
<u>x</u>	Facility Name: <u>Bremerton</u>	Naval Complex: Puge	Soun	d Naval Shi	pyard (Full)		
	Address:						
	City, State, Zip Code:	Washington					
	OU# or Site #: OU C						
<u>x</u>	Primary point of contact:	Brad Gross					
	Organization: Navy						
	Address:						
	City, State, Zip Code:	Washington					
	Phone #: <u>360-396-0028</u>			email: <u>r.gr</u>	oss@navy.mil		
<u>x</u>	Other contacts or vendors wl	no worked on site			None		
^		ly O'Hare			None		
	Type:Vendor, C	•	Ver	ndor Techni	cal Applications	<u>x</u> Oth	ne r
	Organization: Navy		, , ,	idor, recinii	car reprications	<u>x</u> 0u	
		d Acitivity Northwest;	Naval	Facilities E	ngineering Comma	nd: 19917 7th Av	enue NE
	City, State, Zip Code:	Poulsbo, WA 98370					
	Phone #: 360-396-0014			email: cin	dy.o'hare@navy.mi	1	
O	A/QC						
w.	A/40						
	_ Characteristics of Interest						
	Good pre- and post-tre	atment groundwater da	ta		Good pre-	and post-treatme	nt soil data
		ile vs. time information			Flux asses	sment	
	Groundwater elevation	ıs			Geologic o	cross-section	
	Hydraulic Conductivit	y information					

0881

General Site Information

<u>x</u> Impacted	Zone: Length (parallel to flow	v direction)(ft.):	Width (ft):	Thick	ness (ft):		<u>x</u>	Unknown
	Impacted zone a	as defined by documentation	ı					
	Alternative method	od for determining size of in	pacted zone (See source zo	one definition attachmer	nts)			
	Map attachment							
Monitor V	Vells: Number of relevant m	nonitoring wells with ground	water data:					None
			Pre-treatment:		Post-treatment:			
	Number of wells relat	ive to treatment zone:						
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:					
	Number of relevant so	il borings with post-treatmer	nt data:					
	Number inside treatme	ent zone:	_ Number outside	treatment zone:				
x Types of C	contaminants							
				Average Pre-treatme	ent Concentration per	Average Post-treatm	nent Co	oncentration per
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)		Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None		None
	Tetrachloroethene	Jet Fuel	x No. 6 Fuel Oil	None	None	None		None
	1,1-dichloroethene	Napthalene	x Diesel	None	None	None		None
	cis-1,2-dichloroethene	Benzene		None	None	None		None
	trans-1,2-dichloroethene	Tolune		None	None	None		None
	1,1-dichloroethane	Ethylbenzene		None	None	None		None
	1,2-dichloroethane	m/p-xylene		None	None	None		None
	1,1,1-trichloroethane	o-xylene		None	None	None		None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None		None
001100111	1,1,2,2-tetrachloroethane			None	None	None		None
	Vinyl Chloride			None	None	None		None
				None	None	None		None
				None	None	None		None
				None	None	None		None
				None	None	None		None
				None	None	None		None
				None	None	None		None
Comme	nts:							
Attachmen	its:							

0881

General Site Assessment Data

Hyd	rogeologic Conceptu	ial Model				Facility ID#	t: <u>088</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relatively hom Largely permer Largely imperm Competent, bu Weathered bec Relatively hom Relatively hom Largely permer Largely imperm Competent, bu	ogeneous and permeable ogeneous and impermea able sediments with interneable sediments with interneable sediments, sandsto ogeneous and permeable ogeneous and impermea able sediments with interneable sediments	able unconsolidated so- bedded lenses of low ter-bedded layers of low trystalline rock) one e unconsolidated security able unconsolidated so- bedded lenses of low ter-bedded layers of low ter-bedded layers of low trystalline rock)	sediments wer permeabil higher permea diments sediments wer permeabil	ity material
<u>x</u>	Ground surface ele	evation based on wells in o	r adjacent to treatmer	nt zone: <u>~35</u>	ft amsl		Unknown
X	Aquifer Characteris Is more than 1 aqu Depth to water:		No Y Aquifer 1 100	es (number): Aquifer 2	Aquifer 3	known (assume	e single aquifer)
<u>x</u>	Flow direction		<u>SE</u>				
<u>x</u>	Horizontal hydraulic g	c gradient (feet/foot): gradient (feet/foot):				<u>x</u>	Unknown Unknown
<u>x</u>	K range (ft/day)	Measured low high	using: Slu	g Test Labor	atory	Field data	Unknown
	Transmissivity (ft2/	day): Measured low high		g TestLabor	_	Field data <u>X</u>	Unknown
	Comments: _						

The	rmal Treatment - Design											Fac	ility ID#:	088	<u>1</u>
<u>x</u>	Thermal treatment:		_ Condu	ctive											
			_ Electric	cal Re	sistance										
		<u>x</u>	- Steam	3	3 phase		6 pha				oower		DC	power	
		Δ	-		Steam		Steam	n + air		Stear					
			Other (
<u>X</u>	Type of Test:	_ Pilot		· -			System								
<u>x</u>	Geology of Treatment Zone	9:	_		_		ogeneous an	•							
			_				ogeneous an	•							
			<u>></u>				ıble sedimen						•	•	
			-				eable sedim					s of h	nigher perr	neabili	ty material
			-				fractured be			alline	rock)				
	T / /T 7		<u>-</u>				rock, limesto								
<u>X</u>	Treatment Targe Zone:			ated o	inly		_ Vadose only					ated a	and Vadose	zones)	
<u>X</u>	Start of Thermal Test:	Aug-			27			Duration:	2 yea	rs 1 n	<u>10nth</u>				
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	•	No										
v	Treatment Cell Design:														
<u>x</u>	Treatment Cell Design:									v	Unkne		,	_	ft)
	Size of target zone (ft2): Thickness of target zone (ft	٠١٠								<u>x</u>	Unkne		(_ ^	11)
	Depth to top of target zone		e).							<u>x</u>	Unkne				
	Thickness of target zone be		,	hle (ft	١٠					<u>^</u>	Unkne				
	Number of energy delivery			oic (it	,,.					<u>x</u>	Unkn				
	Number of extraction points	-	J.							<u>x</u>	Unkne				
	rumbor of oxidence period									~	Cilian				
<u>x</u>	Temperature Profile:														
	Initial formation temperatur	e (de	g C):									<u>x</u>	Unknown		
	Maximum representative for	rmati	on temp	eratu	re (deg C	C):						<u>x</u>	Unknown		
	Time to reach maximum re	prese	ntative t	tempe	erature (d	ays):						<u>x</u>	Unknown		
	Duration of treatment at rep	oreser	ntative t	empe	rature (da	ays):						<u>x</u>	Unknown		
								Date	<u>e</u>			1	<u>Femperatu</u>	re (deg	<u>1 C)</u>
	Formation temperature imm	nediat	tely post	t-treat	tment:										
	Formation temperature pos	t-trea	tment m	nonito	ring even	nt 1:									
	Duration of post-treatment	monit	oring (d	ays):											
<u>x</u>	Mass of contaminant remov									11			,		77.1
		•	pumping	g:						-			_ kg	<u>x</u>	Unknown
			tream:		_				_	-			_ kg	<u>x</u>	Unknown
	Tota	II.								_ Ib			_ kg	<u>X</u>	Unknown
	Comments:														
	<u></u>														_
	Attachments:														

t and Performance					Facility ID#:	<u>0881</u>
_ Performance						
Remediation Goal:						
_	In Groundwater: -					
	-					
_	In Soil:					
Was the Remediation	on Goal Achieved					
	Comment:					
	-					
_	_ In Soil	-				
	Comment: -					
	-					
General comments	on the thermal applic	ation:				
production pro	blems of the expand					
Lessons Learned						
Lessons Learned Energy Total Energy Used:			kWhr	kWhr/		Whr/yd ³
Lessons Learned Energy Total Energy Used:			kWhr	kWhr/	kWhr/m ³	kWhr/yd
Lessons Learned Energy Total Energy Used:	tal energy applied to ner energy:	treatment zone:	kWhr	kWhr/		kWhr/yd
Lessons Learned Energy Total Energy Used:	tal energy applied to ner energy:		kWhr	kWhr/	kWhr/m ³	kWhr/yd
Lessons Learned Energy Total Energy Used:	tal energy applied to ner energy:	treatment zone:	kWhr	kWhr/	kWhr/m ³	kWhr/yd
Energy Total Energy Used:	tal energy applied to ner energy:	treatment zone:	kWhr	kWhr/	kWhr/m ³	kWhr/yd
Lessons Learned Energy Total Energy Used: Oth Cost Total Project Cost:	tal energy applied to ner energy:	treatment zone:	kWhr	kWhr/	kWhr/m ³	kWhr/yd
Lessons Learned Energy Total Energy Used: Oth Cost Total Project Cost: Co	tal energy applied to ner energy: Please	treatment zone:	kWhr	kWhr/	kWhr/m ³	kWhr/yd
Energy Total Energy Used:OthCost Total Project Cost:Co	tal energy applied to ner energy: Please	treatment zone:	kWhr	kWhr/	kWhr/m ³	kWhr/yd
Energy Total Energy Used:OthCost Total Project Cost:CoTheEnergy	tal energy applied to ner energy: Please nsultant Cost: ermal Vendor Cost:	treatment zone:	kWhr		kWhr/m ³ kWhr/m ³	kWhr/yd
Lessons Learned Energy Total Energy Used: Oth Cost Total Project Cost: Co In The Energy Coth	tal energy applied to ner energy: Please nsultant Cost: ermal Vendor Cost: ergy Cost:	treatment zone:	kWhr		kWhr/m ³ kWhr/m ³	kWhr/yd
Energy Total Energy Used: Oth Cost Total Project Cost: Co The Energy	tal energy applied to ner energy: Please Insultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1:	treatment zone:	kWhr		kWhr/m ³ kWhr/m ³	kWhr/yd
Energy Total Energy Used: Oth Cost Total Project Cost: Co The Energy	tal energy applied to her energy: Please Insultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1: her Cost 2: her Cost 3:	treatment zone:	kWhr		kWhr/m ³ kWhr/m ³	Whr/yd ³ kWhr/yd ⁱ kWhr/yd ⁱ

____ Other Cost 3:

PD ____ File Analyzed By: Date: 10/18/2006 ____Steam ____Other: Type of treatment: Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides Chlorinated Solvents Petroleum Hydrocarbons _Wood Treating _Other: Treatment Status: ___ Active Post Type of Test: _ Pilot Test Full Scale System Start of Test: May-99 End of Test: Aug-99 Duration: 75 d Type of Site: Non-DOD __ DoD Facility Name: Former Dry Cleaners Address: City, State, Zip Code: Western Washington OU# or Site #: _ Primary point of contact: Bill Heath Organization: **CES** Address: 419 Entiat St., Suite A City, State, Zip Code: Kennewick, WA 99336 Phone #: 509-727-4276 email: bill@cesiweb.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0890

General Site Information

___ Hydraulic Conductivity information

General Site As	ssessment Data					Facility II	D#: <u>0890</u>
Impacted	Impacted zone a	v direction)(ft.):			ness (ft):		Unknown
	Map attachment		ipacied zone (See Source 20	ne definition attachmen	is)		
Monitor	Wells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	ive to treatment zone:	. To trouble				
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin	=	il borings with pre-treatment					
	Number of relevant so	il borings with post-treatmer	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
x Types of	Contaminants						
				Average Pre-treatme	nt Concentration per nical:		ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	None	None	None	None
	<u>x</u> Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	x cis-1,2-dichloroethene	Napatatene Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1.1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane						
	1,1,1-trichloroethane	m/p-xylene		None	None	None	None
Chemicals of		o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	ente:						
Confine							
			-				
Attachme	ents:						
	-						

Hydr	ogeologic Conceptual	Model		Facility ID#: 0890
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated second relatively homogeneous and impermeable unconsolidated second relatively homogeneous and impermeable unconsolidated second relatively permeable sediments with inter-bedded lenses of low low Largely impermeable sediments with inter-bedded layers of low Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated second relatively homogeneous and impermeable unconsolidated second relatively permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of low Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material higher permeability material diments sediments wer permeability material
<u></u>	Ground surface eleva		adjacent to treatment zone: ft amsl	Unknown
	Is more than 1 aquife	r present?	No Yes (number): <u>x</u> Un	nknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3 2 4 ———————————————————————————————	
	_ Horizontal hydraulic g	gradient (feet/foot):		Unknown
	Vertical hydraulic grad	dient (feet/foot):		Unknown
	K range (ft/day)	Measured low high	using: Slug Test Laboratory	Field data Unknown
	Transmissivity (ft2/da	y): Measured low high	using: Slug Test Laboratory	Field dataUnknown
	Comments:			

The	rmal Treatment - Design								Facility ID#:	<u>0890</u>
<u>x</u>	Thermal treatment:		_ Conduct	ive						
		<u>x</u>	Electrica	l Resistance						
			_	3 phase	_	_ 6 phase		AC power	DO	power
			_ Steam							
			_	Steam	_	Steam + air		Steam + O2	2	
			Other (d							
<u>X</u>	Type of Test:	_ Pilot	test	_	-scale Syste					
<u>X</u>	Geology of Treatment Zone	e:	_			eous and permea				
			_	-	_	eous and imperm				
			<u>X</u>			sediments with int			•	
			_			e sediments with			s of nigher per	neability material
			_			tured bedrock (i.e	-	iline rock)		
	_ Treatment Targe Zone:		 Saturate			, limestone, sands		Poth (Satur	rotad and Vadass	zonos)
	Start of Thermal Test:	May		eu offiy	v a	dose only Duration:		Boui (Satui	ated and Vadose	(Zolles)
<u>X</u>	Hydraulic Control		_ <u>-99</u> _ Yes	No		Duration.	<u>13 u</u>			
	_ riyaraano control		_ 103							
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):							Unkn	nown (_ x ft)
	Thickness of target zone (f	t):			<u>20</u>			Unkn	nown	
	Depth to top of target zone	(ft bg	ıs):		<u>2</u>			Unkn	nown	
	Thickness of target zone be	elow v	water tabl	e (ft):	<u>20</u>			Unkn	nown	
	Number of energy delivery	point	s:		<u>12</u>			Unkn	nown	
	Number of extraction points	s:			<u>4</u>			Unkn	nown	
	_ Temperature Profile:									
	Initial formation temperatur	e (de	g C):						Unknow	1
	Maximum representative for		-	rature (deg C	C):				Unknow	1
	Time to reach maximum re	prese	ntative te	mperature (d	ays):				Unknow	1
	Duration of treatment at rep	prese	ntative te	mperature (da	ays):				Unknow	1
						Dat	t <u>e</u>		Temperatu	re (deg C)
	Formation temperature imp	nedia	tely post-	treatment:						
	Formation temperature pos	st-trea	itment mo	nitoring even	nt 1:					
	Duration of post-treatment	monit	oring (da	ys):						
	_ Mass of contaminant remo	ved:								
	_ Via∃	liquid	pumping:					lb	kg	Unknown
	In va	apor s	tream:					lb	kg	Unknown
	Tota	al:					<u>x</u>	lb	kg	Unknown
	Comments:									
	Attachments:									

Cost and Performance Facility ID#: 0890 Performance Remediation Goal: In Groundwater: PCE = 5 ug/LIn Soil: PCE = 500 ug/kgWas the Remediation Goal Achieved: ____ In Groundwater Comment: -___ In Soil Comment: General comments on the thermal application: Lessons Learned Energy ____ kWhr/yd³ ____ kWhr/m³ Total Energy Used: ____ kWhr kWhr/m³ _ kWhr/yd³ __ Total energy applied to treatment zone: ____ Other energy: kWhr/m³ kWhr/yd³ _ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ____ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3:

Other Cost 1:
Other Cost 2:
Other Cost 3:

_ Please note other cost:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD					Date:	11/9/2006
	Type of treatment:	Conductive	<u>X</u>	Steam	ERH	Other:		
	Type of Contaminant:	Chlorinated Sol	vents	_	Petroleum Hydroca	arbons	Pesticides	
		X Wood Treating			Other:			
	Treatment Status:	Active	$\underline{\mathbf{X}}$	Post				
	Type of Test:	X Pilot Test		Full Scal	e System			
	Start of Test:	10/1/2002		End	of Test: 4/15/2003		Duration: 6.5	months
	Type of Site:	Non-DOD	<u>X</u>	DoD				
<u>X</u>	Facility Name: Wyckoff /	Eagle Harbor						
	Address:							_
	City, State, Zip Code:	Bainbridge Island, Wa	shingt	on				
	OU# or Site #: Former Pr	ocess Area						
<u>X</u>	Primary point of contact:	Mary Jane Nearman						
_	Organization: EPA							
	City, State, Zip Code:							
	Phone #: 206-553-6642			email:				
<u>X</u>	Other contacts or vendors wl	ho worked on site			None			
^		t Allen			None			
	Type: X Vendor, C		Von	dor Techn	ical Applications	Oth	nor	
	_	Corp of Engineers	_ , c	dor, recini	rear rippireations			
		Corp or Engineers						
	City, State, Zip Code:							
	Phone #: <u>206-764-3697</u>			email: ma	tthew.s.allen@usace.a	rmy.mil		
^	A /O.C.							
Q,	A/QC							
	_ Characteristics of Interest							
		eatment groundwater dat	a		Good pre- an	d post-treatme	nt soil data	
		file vs. time information			Flux assessm	_		
	Groundwater elevation				Geologic cro			
	Hydraulic Conductivit	y information						

<u>0900</u>

General Site Information

Gene	eral Site Ass	sessment Data					Facility II	D#: <u>0900</u>
<u>X</u>	Impacted 2			Width (ft):	Thick	ness (ft):		X Unknown
			as defined by documentation		d-6-16			
			-	npacted zone (See source zo	ne definition attachmen	its)		
		Map attachment						
<u>x</u>	Monitor W	/ells: Number of relevant m	nonitoring wells with ground	water data:				None
Δ.	WOTHER V	rens. Humber of relevant in	formorning wells with grounds	Pre-treatment:	15	Post-treatment:	<u>15</u>	None
		Number of wells relat	ive to treatment zone:	r to additional	<u></u>	Tool troutmont.	<u></u>	
		Pre-treatment	ln: 15	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In: <u>15</u>	Upgradient:	Downgradient:	Cros	ssgradient:	
<u>X</u>	Soil Boring	s: Number of relevant so	il borings with pre-treatment	t data: <u>15</u>				
		Number of relevant so	il borings with post-treatmer	nt data: <u>15</u>				
		Number inside treatme	ent zone:	Number outside	treatment zone:			
<u>X</u>	Types of C	ontaminants		TI.	11			
					Average Pre-treatme	nt Concentration per	Average Post-treatm	ent Concentration per
					Chen			nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	X <u>Creosote</u>	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	X Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
Che	emicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
			-		None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
	Comme	nts:						
		Estimated loss of 17 000	0 to 41 000 callans of	duat. No roal are treat-	at GW comples T	poraturos as bisk	. E0 to 60 doc C is	nor aquifer are:
		ESUITIALED IOSS OF 17,000		duct. No real pre-treatmer as temperatures around ex				per aquirer around
	Attachmen	ts:						

Hyd	rogeologic Conceptual	l Model		Facility ID#: 0900
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated St. Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated so Relatively homogeneous and impermeable unconsolidated St. Largely permeable sediments with inter-bedded lenses of Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	d sediments lower permeability material of higher permeability material sediments d sediments lower permeability material
	_ Ground surface elev	ation based on wells in o	adjacent to treatment zone: ft amsl	Unknown
<u>X</u>	Aquifer Characteristi		-	Unknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3 5 80 200 10 200 1500+	_
<u>x</u>	Flow direction		Radially toward Eagle Harbor and Puget Sound	
X	Horizontal hydraulic Vertical hydraulic gra	• , ,		<u>X</u> Unknown <u>X</u> Unknown
<u>X</u>	K range (ft/day)	Measured low high	sing: Slug Test Laboratory	Field data Unknown
	Transmissivity (ft2/da	· ·	-	Field data Unknown
	Comments:			
	Attachments:	erage K=26 ft/day. Ve	rtical anisotropy = 4.7	

The	ermal Treatment - Design							Faci	lity ID#:	<u>0900</u>
<u>X</u>	Thermal treatment:		Conduc	tive						
			Electric	al Resistance						
			_	3 phase		_ 6 phase	AC	power	DC	power
		<u>X</u>	Steam							
			-	Steam	_	Steam + air	Stea	m + O2		
			Other (describe)						
<u>X</u>	Type of Test: X		ot test	Full-	-					
<u>X</u>	Geology of Treatment Zor	ne:	-		_	eous and permea				
			-			eous and imperme				
			<u>X</u>			sediments with into				-
			-		-	e sediments with i		-	igner perm	neability material
			-			tured bedrock (i.e , limestone, sands	-	TOCK)		
<u>X</u>	Treatment Targe Zone:		Saturat	ted only	Va			n (Saturated a	nd Vadose	zones)
<u>^</u> X	Start of Thermal Test:		_ Satura	ieu only	v a	•	_	i (Saturateu a		
<u>^</u>	Hydraulic Control	X	Yes	No		Duration.				
	Trydraulio Control	~	103	110						
<u>X</u>	Treatment Cell Design:									
	Size of target zone (ft2):				20125			Unknown	(x ft)
	Thickness of target zone ((ft):			19 to 29			_ Unknown		
	Depth to top of target zone	gs):		<u>6</u>			_ Unknown			
	Thickness of target zone b	water tab	ole (ft):	10 to 20			Unknown			
	Number of energy delivery	ts:		<u>16</u>			Unknown			
	Number of extraction poin	ts:			7			_ Unknown		
<u>X</u>	Temperature Profile:									
	Initial formation temperatu	ıre (de	eg C):			<u>15</u>			Unknown	
	Maximum representative f	forma	tion tempe	erature (deg C)):	<u>70</u>			Unknown	
	Time to reach maximum r	epres	entative te	emperature (da	ays):	<u>128</u>			Unknown	
	Duration of treatment at re	eprese	entative te	emperature (da	ys):	<u>42</u>			_ Unknown	
						<u>Dat</u>	<u>e</u>	<u>]</u>	emperatur	e (deg C)
	Formation temperature im	media	ately post-	-treatment:						
	Formation temperature po	st-tre	atment m	onitoring event	:1:	-				
	Duration of post-treatment	t mon	itoring (da	ays):						
<u>X</u>	Mass of contaminant remo	oved:								
	Via	liquic	l pumping	j :	<u>~93</u>	<u>00</u>	lb	<u>X</u>	kg	Unknow
		-	stream:				lb		_ kg	Unknow
	Tot	al:			<u>~110</u>	<u>00+</u>	lb	<u>X</u>	kg	Unknow
	Comments:									
	Attachments:									

Cos	t and Performand	е			Facility ID#: 0900
X	Performance				
_	Remediation G	oal:			
		X In Ground	water:		
		_		Meet Puget So	ound marine water quality and surface water quality.
		X In Soil:			
				Puget Sound	marine sediment standards at the mud line.
					
	Was the Remed	diation Goal Achie	eved:		
		In Ground	water		
		Com	ment:		
			-		
		In Soil			
		Com	ment: —		
	General comme	ents on the therma	al annlicati	ion:	
	Conordi commi	and on the therme	л аррпоац	on.	
	01: "	4) 1			L'I NADI O' L
	exceed P	s: 1) demonstrate uget Sound marin	e water qu	n will remove almost all mulality, surface water quality	obile NAPL; 2) show post treatment GW concentrations will not and sediment standards at the mud line; 3) demo that surface
					Mode 1 Toxic Control Act (MTCA) Method B cleanup levels. d extraction rates were not achieved.
	<u>00315 a5 1</u>	Ji Sulliller 2004.		iotes. system injection and	restraction rates were not achieved.
	Lessons Learne	ed			
<u>X</u>	Energy				
	Total Energy Us	sed:			kWhr kWhr/m ³ kWhr/yd ³
		_ Total energy app	plied to tre	atment zone:	kWhr/m ³ kWhr/yd ³
		Other energy:			kWhr/m ³ kWhr/yd ³
		<u>X</u>	Please n	ote other energy:	9400 x 10E6 BTU ????
<u>X</u>	Cost				
	Total Project Co	ost:	9	9,750,000	
		_ Consultant Cost			_
		_ Thermal Vendor	· Cost:		_
		_ Energy Cost:			$\underline{\hspace{1cm}}$ m^3 $\underline{\hspace{1cm}}$ yd^3
	<u>X</u>	Other Cost 1:		<u>1,193,000</u>	
	<u>X</u>	Other Cost 2:		5,644,000	
	<u>X</u>	Other Cost 3:		2,370,000	
	X Please no	te other cost:	<u>X</u>	Other Cost 1:	Steam operation and maintenance
			Х	Other Cost 2:	Installation and treatment systme upgrades

X Other Cost 3:

Resign and planning and construction oversight

File Analyzed By: PD ____ Date: Type of treatment: Conductive ___Steam ____Other: Type of Contaminant: Chlorinated Solvents Petroleum Hydrocarbons Pesticides Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test Full Scale System Start of Test: Nov-00 End of Test: Mar-01 Duration: 4 months Type of Site: Non-DOD _ DoD Facility Name: <u>Delevan Municipal Well No. 4</u> Address: City, State, Zip Code: Delevan, WI OU# or Site #: Primary point of contact: Tom Wentland Organization: WI Department of Natural Resources Address: 115 Pilgram Road City, State, Zip Code: Plymouth, WI 53073-4294 Phone #: 920-892-8756 x 3028 email: wentlt@dnr.state.wi.us Other contacts or vendors who worked on site _None Point of contact: Jon Raymond Type: Vendor, Consultant ___ Vendor, Technical Applications __Other Organization: Pentair Water Address: City, State, Zip Code: Phone #: <u>262-728-7216</u> email: jon.raymond@pentairwater.com QA/QC ___ Characteristics of Interest ____ Good pre- and post-treatment groundwater data __ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0910

General Site Information

___ Hydraulic Conductivity information

General Site As	ssessment Data					Facility II	D#: <u>0910</u>						
Impacted	.	v direction)(ft.):s defined by documentation		Unknown									
		Alternative method for determining size of impacted zone (See source zone definition attachments)											
	Map attachment	-	.pastoa 20110 (000 000100 20		,								
	map attackment												
Monitor Wells: Number of relevant monitoring wells with groundwater data: Pre-treatment: Post-treatment:													
	November of coefficients		Pre-treatment:		Post-treatment:								
	Number of wells relati		He was discuss.	D	0								
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:							
Post-treatment In: Upgradient: Downgradient: Crossgradient:													
Soil Borin	gs: Number of relevant so	il borings with pre-treatment	data:										
	Number of relevant so	il borings with post-treatmer	nt data:										
	Number inside treatme	ent zone:	Number outside	treatment zone:									
x Types of 0	Contaminants	1											
				Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:						
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)						
	x Trichloroethene	Hexane	Creosote	1,000 mg/L	None	1 mg/L	None						
	x Tetrachloroethene	Jet Fuel		None	None	None	None						
	1,1-dichloroethene	Napthalene		None	None	None	None						
	cis-1,2-dichloroethene	Benzene		None	None	None	None						
	trans-1,2-dichloroethene	Tolune		None	None	None	None						
	1,1-dichloroethane	Ethylbenzene		None	None	None	None						
	1,2-dichloroethane	m/p-xylene		None	None	None	None						
	1,1,1-trichloroethane	o-xylene		None	None	None	None						
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None						
	1,1,2,2-tetrachloroethane			None	None	None	None						
	Vinyl Chloride			None	None	None	None						
	x Total VOCs at 16 ft			None	10,000 mg/kg	None	0.5 mg/kg						
	x Total VOCs at 20 ft			None	100 mg/kg	None	1 mg/kg						
	x Total VOCs at 24 ft			None	100 mg/kg	None	1 mg/kg						
	x Total VOCs at 26 ft			None	1,000 mg/kg	None	5 mg/kg						
	x Total VOCs			0.5 mg/L	None	0.05 mg/L	None						
				None	None	None	None						
Comme	ents:												
Attachme	nts:												

Hydrogeologic Conceptual Model Facility ID#: 0910 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _ Unknown _ Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: _ Flow direction _ Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: __ Slug Test Field data Laboratory ____ Unknown low high Transmissivity (ft2/day): Measured using: ____ Slug Test ____ Laboratory __ Field data low ____ Unknown high Comments:

The	rmal Treatment - Design								Facility ID#:	<u>0910</u>
<u>x</u>	Thermal treatment:		_ Conductive							
		<u>x</u>	Electrical R	esistance						
				3 phase		6 phase		AC power	DC	power
			_ Steam	Steam		Steam + air	r	Steam + O	2	
			Other (desc	='		Steam + an		. Steam + O	_	
<u>x</u>	Type of Test:	Pilot			-scale	System				
<u>x</u>	Geology of Treatment Zone	_		_		ogeneous and per	rmeable und	onsolidate	ed sediments	
_			x			ogeneous and imp				
			_	-		able sediments wit				ability material
				Largely in	npern	neable sediments	with inter-be	edded laye	rs of higher per	meability materia
						t fractured bedroc				
				Weathere	ed bed	drock, limestone, s	sandstone			
<u>x</u>	Treatment Targe Zone:		_ Saturated	only	<u>x</u>	Vadose only		Both (Satu	rated and Vadose	zones)
	_ Start of Thermal Test:					Dura	ation:			
	_ Hydraulic Control		Yes	No						
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				_			Unk	`	<u>40</u> x <u>40</u> ft
	Thickness of target zone (f				22				nown	
	Depth to top of target zone				<u>6</u>				nown	
	Thickness of target zone be			ft):	0				nown	
	Number of energy delivery	-	5:		<u>6</u>			Unk		
	Number of extraction points	S:			<u>4</u>			Unk	nown	
<u>x</u>	Temperature Profile:									
	Initial formation temperatur	e (de	g C):						Unknow	n
	Maximum representative for	ormati	on temperat	ure (deg C	C):	<u>66</u>			Unknow	n
	Time to reach maximum re	prese	ntative temp	erature (d	ays):	<u>7</u>			Unknow	n
	Duration of treatment at rep	presei	ntative temp	erature (da	ays):	<u>120</u>			Unknow	n
	Formation to an austrus ince						<u>Date</u>		Temperatu	ire (deg C)
	Formation temperature imp				. 4 1 .					
	Formation temperature pos Duration of post-treatment			_	н т.	912 (2.5 ye	aarc)		-	
	Duration of post treatment	11101111	oring (days)			<u> </u>	<u>cars)</u>			
	_ Mass of contaminant remo	ved:								
	Via I	liquid	pumping:					lb	kg	Unkno
	In va	apor s	tream:	_				lb	kg	Unkno
	Tota	al:						lb	kg	Unkno
	Comments:									
	<u>1540 yd3</u>	- tre	ated							
	Attachments:									

Cost and	Performance						Facility ID#:	<u>0910</u>
Perf	formance							
	nediation Goal:							
		_ In Groundwat	er: —					
		_	_					
		_ In Soil:						
Was	the Remediation	n Goal Achieve	d:					
		_ In Groundwat	er					
		Comme	nt: —					
			_					
		_ In Soil						
		Comme	nt: —					
Gen	eral comments o	n the thermal a	pplicati	on:				
Laar	nona Laarnad							
Less	sons Learned							
								
Ene	rav							
					1-3371	14\A/la #/ma 3		kWhr/yd ³
1018	al Energy Used:		-l 4 - 4		kWhr			
		al energy applie	a to tre	eatment zone:			_ kWhr/m ³	kWhr/yd ³
	Oth	er energy:					_ kWhr/m ³	kWhr/yd ³
		PI	ease n	ote other energy:				
<u>x</u> Cos	t							
_	al Project Cost:			\$42/yd3				
1010	-	sultant Cost:		<u> </u>				
			oot:					
		rmal Vendor Co	Jol.		m ³		v.d ³	
		ergy Cost:		50000	m ⁻		_yd³	
		er Cost 1:		50000				
	_	er Cost 2:		<u>20000</u>				
	<u></u>	er Cost 3:		-				
<u>x</u>	Please note oth	ner cost:	<u>x</u>	Other Cost 1:		capital	cost	
			<u>x</u>	Other Cost 2:		<u>O&M c</u>	ost	

___ Other Cost 3:

File Analyzed By: PD ____ Date: 10/30/2006 ____Steam Type of treatment: Conductive <u>x</u> ERH ____Other: Type of Contaminant: _____Pesticides Chlorinated Solvents _ Petroleum Hydrocarbons Wood Treating Other: Treatment Status: _Active Post X ___ Full Scale System Type of Test: _Pilot Test Start of Test: End of Test: _____ Duration: 60 d Type of Site: Non-DOD ____DoD Facility Name: Confidential; Racine, Wi Address: City, State, Zip Code: Racine, WI OU# or Site #: Primary point of contact: Dacre Bush Organization: McMillian-McGee Address: City, State, Zip Code: Phone #: 805-295-9071 email: dacre.bush@mcmillian-mcgee.com Other contacts or vendors who worked on site _ None Point of contact: Mark M. Mejac Type: Vendor, Consultant ____ Vendor, Technical Applications __Other Organization: STS Consulting Address: 11425 West lake Park Drive City, State, Zip Code: Milwaukee, WI 53224-3025 Phone #: 414-359-3030 email: mejac@stsconsultants.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0915

General Site Information

___ Hydraulic Conductivity information

<u>x</u> Impacted		w direction)(ft.): <u>below</u>	Width (ft):	Thick	ness (ft): 18 to 2	<u>4</u>	Unknown				
	= :	nod for determining size of im		one definition attachmen	its)						
	Map attachment										
Monitor V	Vells: Number of relevant n	nonitoring wells with grounds		None							
	North an of wells as let	d	Pre-treatment:								
	Number of wells relative	tive to treatment zone:	Upgradient:	Downgradient:	Down are dient:						
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:					
	FOSI-treatment	In:	Opgradient.	Downgradient.		ssgradient.					
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:								
	Number of relevant so	oil borings with post-treatmer	nt data:								
	Number inside treatme	ent zone:	_ Number outsid	e treatment zone:							
Types of 0	Contaminants	I	T	I		<u> </u>					
				Average Pre-treatme	ent Concentration per nical:		nent Concentration per mical:				
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	Trichloroethene	Hexane	Creosote	None	None	None	None				
	Tetrachloroethene	Jet Fuel		None	None	None	None				
	1,1-dichloroethene	Napthalene	<u>x</u>	None	None	None	None				
	cis-1,2-dichloroethene	Benzene		None	None	None	None				
	trans-1,2-dichloroethene	Tolune		None	None	None	None				
	1,1-dichloroethane	Ethylbenzene		None	None	None	None				
	1,2-dichloroethane	m/p-xylene		None	None	None	None				
Observiced of	1,1,1-trichloroethane	o-xylene		None	None	None	None				
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None				
	1,1,2,2-tetrachloroethane			None	None	None	None				
	Vinyl Chloride			None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
Comme	ents:										
		Impacted area -	10,500 ft2 to depth ranging	ng between 18 and 24	ft (ie 7200 vd3 imn	acted)					
		paotod area -	. 5,555 NE 13 dopin rangii	Journal To and 24	00.250 yao imp						
Attachmer	nts:										

0915

General Site Assessment Data

____ Unknown

low

high

Comments:

Attachments:

X Electrical Resistance	
3 phase6 phaseAC powerDC powerSteamSteam + airSteam + O2Other (describe)Type of Test:Pilot testFull-scale SystemSteam + airSteam + O2Other (describe)Type of Test:Pilot testFull-scale SystemRelatively homogeneous and permeable unconsolidated sedimentsRelatively homogeneous and impermeable unconsolidated sediments	
SteamSteam + airSteam + O2Other (describe)Type of Test:Pilot testFull-scale SystemRelatively homogeneous and permeable unconsolidated sedimentsRelatively homogeneous and impermeable unconsolidated sediments	
SteamSteam + airSteam + O2Other (describe)Type of Test:Pilot testFull-scale System Geology of Treatment Zone:Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments	
Other (describe)Type of Test:Pilot testFull-scale SystemRelatively homogeneous and permeable unconsolidated sedimentsRelatively homogeneous and impermeable unconsolidated sediments	
Type of Test:Pilot testFull-scale System	
 Geology of Treatment Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments 	
Relatively homogeneous and impermeable unconsolidated sediments	
	
Langeling and the configuration of the first of the first of the first of the configuration o	
Largely permeable sediments with inter-bedded lenses of lower permeability m	materia materia
<u>x</u> Largely impermeable sediments with inter-bedded layers of higher permeability	
Competent, but fractured bedrock (i.e. crystalline rock)	
Weathered bedrock, limestone, sandstone	
Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones)	
Start of Thermal Test: Duration:	
Hydraulic Control Yes No	
Treatment Cell Design:	
Size of target zone (ft2): Unknown (x	ft)
Thickness of target zone (ft):	
Depth to top of target zone (ft bgs):	
Thickness of target zone below water table (ft):	
Number of energy delivery points: 31 Unknown	
Number of extraction points: 12 Unknown	
T	
Temperature Profile:	
Initial formation temperature (deg C): Unknown	
Maximum representative formation temperature (deg C): Unknown	
Time to reach maximum representative temperature (days): Unknown	
Duration of treatment at representative temperature (days): Unknown	
<u>Date</u> <u>Temperature (deg</u>	<u>C)</u>
Formation temperature immediately post-treatment:	
Formation temperature post-treatment monitoring event 1:	
Duration of post-treatment monitoring (days):	
Mass of contaminant removed:	
	Unknov
· · · · · · · · · · · · · · · · · · ·	Unknov
	Unknov
Total: lb kg	UIKHOV
Comments:	
Spacing 23'	
Attachments:	
Automotio.	

Cos	at and Performance					Facility ID#:	<u>0915</u>
	_ Performance						
	Remediation Goal:						
		In Groundwater: —					
		_					
		In Soil:					
	_						
	Was the Remediation	on Goal Achieved:					
		In Groundwater					
		Comment: -					
		_					
		In Soil					
		Comment: -					
	General comments	on the thermal applica	ation:				
	Lessons Learned						
	F						
<u>X</u>	Energy						3
	Total Energy Used:	· 		kWhr			Vhr/yd ³
		tal energy applied to to	reatment zone:			_ kWhr/m ³	kWhr/yd ³
	Oth	ner energy:			-	_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
	_ Cost						
	Total Project Cost:						
	·						
	· 	nsultant Cost:					
		ermal Vendor Cost:			2	2	
		ergy Cost:			m ³	_ yd³	
	Oth	ner Cost 1:					
	Oth	ner Cost 2:					
	Oth	ner Cost 3:					
	Please note of	ther cost:	Other Cost 1:				
		<u></u>	Other Cost 2:				

____ Other Cost 3:

<u>x</u> PD ____ File Analyzed By: Date: ____Steam Type of treatment: ___ Conductive ERH **RFH** Type of Contaminant: _ Chlorinated Solvents <u>X</u> Petroleum Hydrocarbons Pesticides ___ Wood Treating Other: JP-4 <u>X</u> Treatment Status: ___ Active Post X Type of Test: Pilot Test Full Scale System Start of Test: End of Test: _____ Duration: _____ Type of Site: DoD __Non-DOD <u>x</u> Facility Name: Volk Airfield National Guard City, State, Zip Code: Camp Douglas, WI OU# or Site #: _ Primary point of contact: Steve Buston Organization: National Guard Address: City, State, Zip Code: Phone #: 608-427-1587 email: ____ Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: Address: City, State, Zip Code: Phone #: email: __ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

0920

General Site Information

___ Hydraulic Conductivity information

<u>x</u> Impacted	Zone: Length (parallel to flow	w direction)(ft.):	Width (ft):	Thick	ness (ft):	<u></u>	<u>x</u> Unknown				
	Impacted zone a	Impacted zone as defined by documentation									
	Alternative meth	Alternative method for determining size of impacted zone (See source zone definition attachments)									
	Map attachment										
Monitor \	Wells: Number of relevant m	nonitoring wells with ground	water data:				None				
			Pre-treatment:		Post-treatment:						
	Number of wells relat	tive to treatment zone:									
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:					
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:					
				· ·		· —					
Soil Borin	gs: Number of relevant so	oil borings with pre-treatmen	t data:								
	-	Number of relevant soil borings with post-treatment data:									
	Number inside treatme			e treatment zone:							
	rumber melde dedun										
x Types of 0	Contaminants										
x Types of t	Contaminants										
				Average Pre-treatme	ent Concentration per		ent Concentration per nical:				
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	Trichloroethene	Hexane	Creosote	None	None	None	None				
	Tetrachloroethene	Jet Fuel	x JP-4	None	None	None	None				
	1,1-dichloroethene	Napthalene		None	None	None	None				
	cis-1,2-dichloroethene	Benzene		None	None	None	None				
	trans-1,2-dichloroethene Tolune			None	None	None	None				
	1,1-dichloroethane	Ethylbenzene		None	None	None	None				
	1,2-dichloroethane	m/p-xylene		None	None	None	None				
	1,1,1-trichloroethane	o-xylene		None	None	None	None				
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None				
Concern	1,1,2,2-tetrachloroethane			None	None	None	None				
	Vinyl Chloride			None	None	None	None				
	vinyi cinonae			None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
Comme	ents:										
					=						
Attachme	nts:										

0920

General Site Assessment Data

Hydrogeologic Conceptual Model Facility ID#: 0920 Unconsolidated Sediments Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments __ Largely permeable sediments with inter-bedded lenses of lower permeability material _ Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) _ Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: Unknown Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): Unknown (assume single aquifer) Aquifer 1 Aquifer 2 Aquifer 3 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: Flow direction Horizontal hydraulic gradient (feet/foot): Unknown Vertical hydraulic gradient (feet/foot): Unknown K range (ft/day) Measured using: ___ Slug Test Field data Laboratory low Unknown

____ Slug Test

____ Laboratory

Field data

Unknown

high

low

high

Measured using:

Transmissivity (ft2/day):

Comments:

Attachments:

The	rmal Treatment - Design					Facility ID#:	0920
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Resistan	ce				
		3 phas	e	6 phase	AC power	DC	power
		Steam					
		Steam		Steam + air	Steam + C)2	
		X Other (describe)	RFH				
<u>x</u>	Type of Test: <u>x</u>		Full-scale S				
<u>X</u>	Geology of Treatment Zone	_	,	geneous and permeal			
				geneous and imperme			
		_		le sediments with inte		·	-
				able sediments with i			neability material
				ractured bedrock (i.e.			
	Total description of Total description	· 		ock, limestone, sands		. 1 177 1	
<u>X</u>	Treatment Targe Zone:	Saturated only	<u>x</u>	Vadose only		rated and Vadose	
-	_ Start of Thermal Test:			Duration:			
	_ Hydraulic Control	Yes	No				
v	Treatment Cell Design:						
<u>X</u>	Size of target zone (ft2):		<u>72</u>		Unk	nown (_ x ft)
	Thickness of target zone (ft	+/·	7		Unk	-	_ ^ 10
	Depth to top of target zone		0		<u></u> -	nown	
	Thickness of target zone be		<u>v</u>			nown	
	Number of energy delivery				_	nown	
	Number of extraction points				_	nown	
	Trained of extraction points	. .			<u>x</u> Cin	mown	
<u>x</u>	Temperature Profile:						
	Initial formation temperature	e (deg C):				<u>x</u> Unknowr	ı
	Maximum representative fo	ormation temperature (de	eg C):	<u>150</u>		Unknown	ı
	Time to reach maximum rep	presentative temperatur	e (days):	<u>8</u>		Unknown	ı
	Duration of treatment at rep	presentative temperature	e (days):	<u>4</u>		Unknowr	ı
				<u>Dat</u>	<u>e</u>	Temperatu	re (deg C)
	Formation temperature imm	nediately post-treatment	:				
	Formation temperature pos	st-treatment monitoring e	event 1:	-			
	Duration of post-treatment i	monitoring (days):					
<u>x</u>	Mass of contaminant remov						
		liquid pumping:			lb	kg	Unknown
	In va	apor stream:			lb	kg	Unknown
	Total	d:			lb	kg	<u>x</u> Unknown
	Comments:						
	Attachments:						
			•			•	

t and Performance					Facility ID#:	0920
_ Performance						
Remediation Goal:						
	In Groundwater:					
	In Soil:					
Was the Remediation						
	In Groundwater					
	Comment:					
	l= 0=!!					
<u>x</u>	In Soil	Unknown but did see 99%	% reduction in vol	latile hydrocarbon:	s. 94 to 99% red	uction in semi-
	Comment:	volatile hydrocarbons, an	d 83% reduction	on average in hex	adecane with a	boiling point of
		<u>289C</u>				
General comments	on the thermal app	lication:				
						
Lessons Learned						
_ Energy						
Total Energy Used:			kWhr	kWhr/m ³	kW	/hr/yd ³
To	tal energy applied t	o treatment zone:			_ kWhr/m ³	kWhr/y
Ot	her energy:				_ kWhr/m ³	kWhr/y
	Plea	se note other energy:				
_ Cost						
Total Project Cost:						
Co	nsultant Cost:					
Th	ermal Vendor Cost	: <u> </u>				
En	ergy Cost:			m³	yd³	
Ot	her Cost 1:					
Otl	her Cost 2:					
	her Cost 3:					
Please note of		Other Cost 1:				
i loade note o		Other Cost 2:				
		Other Cost 2.				

Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/30/2006
	Type of treatment:	Conductive		_Steam	ERH	<u>x</u>	Other:	<u>RFH</u>	
	Type of Contaminant:	Chlorinated Solv	vents	<u>X</u>	Petroleum Hyd	lrocarbo	ons	Pesticides	
		Wood Treating			_Other:				
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	Pilot Test	<u>X</u>	Full Scale	System				
	Start of Test:			End	of Test:			Duration:	
	Type of Site:	<u>x</u> Non-DOD	_	_DoD					
<u>x</u>	Facility Name: Mobil Oil								
	Address:								_
	City, State, Zip Code:	<u>TX</u>							
	OU# or Site #:								_
<u>x</u>	Primary point of contact:	Ray Kasevich							
_	Organization: KSN Energ	-							
		rd Floor, PO Box 612							
	City, State, Zip Code:	Great Barrington, MA	0123	0					
	Phone #: 413-528-4651	Great Barrington, WAY	0123		evich@ksnenerg	ies com			
	1 Holle II. 413-320-4031			cinan. <u>rkas</u>	eviene kanenerg	ics.com			
	Other contacts or vendors wh	no worked on site			None				
	Point of contact:								
	Type: Vendor, Co	onsultant	_Ven	dor, Technic	cal Applications		Otl	ner	
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:		_	email:					
_									
Q,	A/QC								
	Characteristics of Interest								
	Good pre- and post-trea	atment groundwater dat	a		Good pre	e- and n	ost-treatme	nt soil data	
	Good temperature profi				Flux asse	_			
	Groundwater elevation				Geologic				
	Hydraulic Conductivity				30010g10	2.000-0			
		,							

0930

General Site As	General Site Assessment Data Faci							
Impacted	Impacted zone a				ness (ft):	_	Unknown	
Monitor \	Wells: Number of relevant n	nonitoring wells with ground					None	
	Number of wells relat Pre-treatment Post-treatment	ive to treatment zone: In:	Pre-treatment: Upgradient: Upgradient:	Downgradient:		ssgradient:		
Soil Borin	gs: Number of relevant so	oil borings with pre-treatment	t data:					
		oil borings with post-treatmer						
x Types of	Number inside treatm	ent zone:	_ Number outside	treatment zone:				
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None	None	None	None	
	Tetrachloroethene	Jet Fuel		None	None	None	None	
	1,1-dichloroethene	Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	x Benzene		None	None	None	None	
	trans-1,2-dichloroethene	x Tolune		None	None	None	None	
	1,1-dichloroethane	<u>x</u> Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	x m/p-xylene		None	None	None	None	
	1,1,1-trichloroethane	x o-xylene		None	None	None	None	
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	

Comme	ents:							
	-							
			-					
Attachme	nts:							
	-							

Hydrogeologic Conceptua	al Model		Facility ID#: 0930
Hydrogeologic Conceptua Geology:	al Model Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated segments are largely permeable sediments with inter-bedded lenses of legal Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated segments with inter-bedded lenses of legal Largely permeable sediments with inter-bedded lenses of legal Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock)	ediments sediments ower permeability material f higher permeability material ediments sediments ower permeability material
Aquifer Characteris	tics:	Weathered bedrock, limestone, sandstone radjacent to treatment zone: ft amsl	Unknown
Is more than 1 aqui	fer present?	_	Jnknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3	- - -
Flow direction			_
Horizontal hydraulic	c gradient (feet/foot): radient (feet/foot):		Unknown
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
Transmissivity (ft2/d	low high day): Measured low high	using: Slug Test Laboratory	Unknown Field data Unknown
Comments:			
_			
Attachments:			

The	rmal Treatment - Design					Facility ID#:	0930
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Resistance	ce				
		3 phase	е	6 phase	AC power	DC	power
		Steam					
		Steam	_	Steam + air	Steam + O2	!	
		\underline{x} Other (describe)	RFH				
<u>x</u>	Type of Test:	Pilot test <u>x</u>	Full-scale Syst	tem			
	_ Geology of Treatment Zon	e: Relati	vely homoge	neous and permea	able unconsolidated	d sediments	
		Relati	vely homoge	neous and imperm	neable unconsolida	ted sediments	
		=			ter-bedded lenses	•	-
					inter-bedded layer	s of higher pern	neability material
				ctured bedrock (i.e			
				k, limestone, sand			
-	_ Treatment Targe Zone:	Saturated only	V	-	Both (Satur		
	_ Start of Thermal Test:			_ Duration	:		
-	_ Hydraulic Control	Yes 1	No				
	_ Treatment Cell Design:						
-	Size of target zone (ft2):				Unkn	own (_ x ft)
	Thickness of target zone (fiz.).	f+\·			Unkn	-	x ft)
	Depth to top of target zone				Unkn		
	Thickness of target zone b		-		Unkn		
	Number of energy delivery				Unkn		
	Number of extraction point				Unkn		
	rumber er extraetien penn	.	-				
	_ Temperature Profile:						
	Initial formation temperature	re (deg C):				Unknown	
	Maximum representative for	ormation temperature (de	eg C):			Unknown	
	Time to reach maximum re	epresentative temperature	e (days):			Unknown	
	Duration of treatment at re	presentative temperature	e (days):			Unknown	
				<u>Da</u>	<u>te</u>	Temperatur	e (deg C)
	Formation temperature imi	mediately post-treatment	:				
	Formation temperature pos	st-treatment monitoring e	event 1:				
	Duration of post-treatment	monitoring (days):					
	_ Mass of contaminant remo	ived:					
	Via	liquid pumping:			lb	kg	Unknown
	In v	apor stream:	-		lb	kg	Unknown
	Tota	al:			lb	kg	Unknown
	Comments:						
	Attachments:						

t and Performance					Facility ID#:	<u>0930</u>
_ Performance						
Remediation Goal:	_					
	_ In Groundwater: -					
	<u>-</u>					
	In Soil:					
Was the Remediation						
_	_ In Groundwater _					
	Comment: -					
	_					
	_ In Soil _					
	Comment: -					
	_					
General comments o	on the thermal applica	ation:				
						
Lessons Learned						
_ Energy						
Total Energy Used:			kWhr	kWhr/m ³	kV	Vhr/vd ³
	al energy applied to t	treatment zone.			kWhr/m ³	kWhr/y
	er energy:				_ kWhr/m³	kWhr/y
		note other energy.			KVVIII/III	KVVIII/y
	Please	note other energy:	-			
Cost						
Total Project Cost:						
-	nsultant Cost:					
	rmal Vendor Cost:					
	ergy Cost:			_ m ³	_ yd ³	
· · · · · · · · · · · · · · · · · · ·	er Cost 1:				_ ,~	
	er Cost 1. er Cost 2:					
						
· · · · · · · · · · · · · · · · · · ·	er Cost 3:	011 0 : 1				
Please note oth	ner cost:	Other Cost 1:				
		Other Cost 2:				

Other Cost 3:

File Analyzed By: <u>x</u> PD ____ Date: 10/18/2006 Type of treatment: ___ Conductive ____ Steam ____Other: Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: ____ Active Post Type of Test: ___ Pilot Test ___ Full Scale System Start of Test: 1-Nov End of Test: 1-Jun Duration: 9 months Type of Site: Non-DOD __ DoD Facility Name: Baker Petrolite Address: City, State, Zip Code: Calgary, Alberta, Canada OU# or Site #: Primary point of contact: Lacy Rosson Organization: Baker Petrolite Address: City, State, Zip Code: Phone #: <u>281-276-5400</u> email: lacy.rosson@bakerpetrolite.com Other contacts or vendors who worked on site _None Point of contact: Katherine Lundy Type: _ Vendor, Consultant ___ Vendor, Technical Applications __Other Organization: Kaizen Environmental Services Address: City, State, Zip Code: Phone #: 403-297-0216 (1-888-525-5902) email: _ QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

0940

General Site Information

___ Hydraulic Conductivity information

General Site As	General Site Assessment Data							
Impacted	Impacted zone a				ness (ft):	_	Unknown	
Monitor V	Map attachment Wells: Number of relevant n	nonitoring wells with ground	water data:				None	
			Pre-treatment:		Post-treatment:			
	Number of wells relat	tive to treatment zone:						
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:		
Soil Borin	=	oil borings with pre-treatment						
		oil borings with post-treatmer						
	Number inside treatme	ent zone:	_ Number outside	treatment zone:				
x Types of 0	Contaminants							
				Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None	None	None	None	
	Tetrachloroethene	Jet Fuel		None	None	None	None	
	1,1-dichloroethene	x Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	Benzene		None	None	None	None	
	trans-1,2-dichloroethene	Tolune		None	None	None	None	
	1,1-dichloroethane	Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	m/p-xylene		None	None	None	None	
	1,1,1-trichloroethane	o-xylene		None	None	None	None	
Chemicals of Concern	1,1,2-trichloroethane	x xylenes		None	None	None	None	
	1,1,2,2-tetrachloroethane			None	None	None	None	
	Vinyl Chloride			None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
				None	None	None	None	
Comme	ents:							
	-							
					<u> </u>			
Attachmer	nts:						-	
	-							

Hyd	rogeologic Conceptua	al Model		Facility ID#:	0940
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sea Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sea Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments ower permeability materia f higher permeability materia ediments sediments ower permeability materia	erial al
<u>x</u>	Ground surface ele	vation based on wells in o	r adjacent to treatment zone: ft amsl	<u>x</u> Unknown	ı
X	Aquifer Characteris Is more than 1 aqui Depth to water:		No Yes (number): X U Aquifer 1 Aquifer 2 Aquifer 3 13	Inknown (assume single aq 	uifer)
	_ Flow direction	CHRIOWII.		-	
	_ Horizontal hydraulic	c gradient (feet/foot): radient (feet/foot):		Unknowr	
<u>x</u>	K range (ft/day)	Measured low high	using: Slug Test Laboratory	Field data Unknown	1
	Transmissivity (ft2/d	day): Measured low high	using: Slug Test Laboratory		ı
	Comments:				
	ĸ	- 10F-6 cm/s			

Attachments:

The	rmal Treatment - Design						Facility ID#:	<u>0940</u>
<u>x</u>	Thermal treatment:	Cond	uctive					
		<u>x</u> Elect	rical Resistance					
			3 phase	6	phase	AC power	DC	power
		Steam	n					
			Steam	5	Steam + air	Steam + O	2	
		Other	r (describe)					
	Type of Test:	Pilot test	Full-	-scale System				
<u>x</u>	Geology of Treatment Zone) :	Relatively	/ homogeneou	s and permeal	ble unconsolidate	d sediments	
			Relatively	/ homogeneou	s and imperme	eable unconsolida	ated sediments	
			Largely p	ermeable sedi	ments with inte	er-bedded lenses	of lower permea	ability material
			x Largely in	npermeable s	ediments with i	inter-bedded laye	rs of higher perr	neability material
						. crystalline rock)		
				ed bedrock, lim	nestone, sands	tone		
	_Treatment Targe Zone:	Satu	rated only	Vadose	•	Both (Satu	rated and Vadose	zones)
<u>X</u>	Start of Thermal Test:	1-Nov			Duration:	9 months		
	_ Hydraulic Control	Yes	No					
.,	Treatment Call Decima							
<u>x</u>	Treatment Cell Design: Size of target zone (ft2):			6450		I II		(6)
	Thickness of target zone (ft	١٠		<u>6458</u>		Unk		x ft)
	Depth to top of target zone						nown	
	Thickness of target zone be		able (ft):			Unk		
	Number of energy delivery		abio (it):	18		Unk		
	Number of extraction points	•		10		Unk		
	•							
	Temperature Profile:							
	Initial formation temperature	e (deg C):		-			Unknown	
	Maximum representative fo	rmation ten	nperature (deg C	;): _			Unknown	
	Time to reach maximum re	presentative	e temperature (d	ays):			Unknown	
	Duration of treatment at rep	resentative	temperature (da	ays):			Unknown	
					Date	<u>e</u>	Temperatu	e (deg C)
	Formation temperature imm	nediately po	st-treatment:	-				
	Formation temperature pos	t-treatment	monitoring even	nt 1: _				
	Duration of post-treatment	monitoring ((days):	-				
<u>x</u>	Mass of contaminant remov					••		
		iquid pumpi				lb	kg	Unknown
		ipor stream:	·	20,1000		lb	kg	Unknown
	Tota	ı:		204000		<u>x</u> lb	kg	Unknown
	Comments:							
	Attachments:							

Cost and Performance Facility ID#: 0940

Remediation Goal:		
<u>x</u>	In Groundwater:	
		source reduction target >95% total recovery
_	In Soil:	
Was the Remediation		
<u>x</u>	In Groundwater	
	Comment:	
		>99.99% source reduction, all MCLs met
_	In Soil	
	Comment:	
General comments	on the thermal app	lication:
-		
-		
		
Energy		
_Energy Total Energy Used:		kWhr kWhr/m³ kWhr/yd³
Total Energy Used:		kWhrkWhr/m³kWhr/yd³
Total Energy Used:	tal energy applied t	to treatment zone:kWhr/m³kWhr/yd³
Total Energy Used:	tal energy applied t her energy:	to treatment zone:kWhr/m³kWhr/yd³kWhr/yd³kWhr/yd³
Total Energy Used:	tal energy applied t her energy:	to treatment zone: kWhr/m³ kWhr/yd³
Total Energy Used:	tal energy applied t her energy:	to treatment zone:kWhr/m³kWhr/yd³kWhr/yd³kWhr/yd³
Total Energy Used: To Oti	tal energy applied t her energy:	to treatment zone:kWhr/m³kWhr/yd³kWhr/yd³kWhr/yd³
Total Energy Used: To Oti Cost Total Project Cost:	tal energy applied t her energy:	to treatment zone:kWhr/m³kWhr/yd³kWhr/yd³kWhr/yd³
Total Energy Used: To Oti Cost Total Project Cost: Co	tal energy applied t her energy: Plea: 	to treatment zone: kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³ se note other energy:
Total Energy Used: To Otl Cost Total Project Cost: Co Th	tal energy applied ther energy: Please	to treatment zone: kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³ se note other energy:
Total Energy Used: To Oti Cost Total Project Cost: Co Th En	tal energy applied ther energy: Please Insultant Cost: ermal Vendor Cost: ergy Cost:	to treatment zone: kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³ se note other energy:
Total Energy Used: To Oti Cost Total Project Cost: Co Th En Oti	tal energy applied ther energy: Please ansultant Cost: ermal Vendor Cost	to treatment zone: kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³ se note other energy:
Cost Total Project Cost: Cost Total Project Cost: Co Th Co Otl	tal energy applied ther energy: Please Insultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1: her Cost 2:	to treatment zone: kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³ se note other energy:
Total Energy Used: Total Project Cost: Cost Total Project Cost: Th En Oti Oti Oti	tal energy applied ther energy: Please ensultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1: her Cost 2: her Cost 3:	to treatment zone:
Cost Total Project Cost: Co Th Cot Total Project Cost: Co Th Co Cot Cot Cot Cot Cot Cot Cot	tal energy applied ther energy: Please ensultant Cost: ermal Vendor Cost: ergy Cost: her Cost 1: her Cost 2: her Cost 3:	to treatment zone: kWhr/m³kWhr/yd³kWhr/m³kWhr/yd³ se note other energy:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/26/2006
	Type of treatment:	Conductive	x	Steam	ER	н _	Other:		
	Type of Contaminant:	Chlorinated Sol	_			n Hydrocar	bons	Pesticides	s
		Wood Treating		<u>x</u>	Other:	<u>PCBs</u>			
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	<u>x</u> Pilot Test		Full Scale	System				
	Start of Test:			End	of Test:			Duration:	
	Type of Site:	<u>x</u> Non-DOD	_	_ DoD					
<u>x</u>	Facility Name: Safety Kle	<u>een</u>							
	Address:								
	City, State, Zip Code:	Breslau, Ontario, Can	<u>ada</u>						
	OU# or Site #:								
<u>x</u>	Primary point of contact:	Lynn Longshore							
	Organization: <u>Safety Kle</u>	een Environmental Heal	th and	Safety					
	Address:								
	City, State, Zip Code:								
	Phone #: <u>18006695740</u>			email:					
_	Other contacts or vendors w	ho worked on site			No	ne			
	Point of contact:								
	Type: Vendor, C				cal Applica		Oth	ier	
	Address:								
	Phone #:		_	email:					
Q	A/QC								
_									
	_ Characteristics of Interest	i .							
	Good pre- and post-tre	eatment groundwater da	ta		Go	od pre- and	post-treatme	nt soil data	
	Good temperature pro-	file vs. time information	1		Flu	x assessme	nt		
	Groundwater elevation	ns			Ge	ologic cross	s-section		
	Hydraulic Conductivit	y information							

1000

General Site A	ssessment Data					Facility II	D#: <u>1000</u>
Impacted	5 "		Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
		=	npacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor	Wells: Number of relevant m	nonitoring wells with ground	water data:				None
			Pre-treatment:		Post-treatment:		
		tive to treatment zone:			_		
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Borin	gs: Number of relevant so	oil borings with pre-treatment	data:				
	Number of relevant so	oil borings with post-treatmer	nt data:				
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Types of	Contaminants	T.	T.	I		T	
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Ca	onto:						
Commo	ents.						
	<u> </u>						
Attachme	nts:						

Hydrogeologic Conceptual	Model		Facility ID#: 1000
Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sec Relatively homogeneous and impermeable unconsolidated sec Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of low Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sec Relatively homogeneous and impermeable unconsolidated sec Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of low Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material higher permeability material diments sediments wer permeability material
		r adjacent to treatment zone: ft amsl	Unknown
Aquifer Characteristic		Y ())	
Is more than 1 aquife	low value (ft bgs): high value (ft bgs): Unknown:	No Yes (number): Un Aquifer 1 Aquifer 2 Aquifer 3	aknown (assume single aquifer)
Flow direction			
Horizontal hydraulic			Unknown
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
Transmissivity (ft2/da	low high		Unknown Field data Unknown
Comments:			
Attachments:			

The	rmal Treatment - Design							Facility ID#:	1000
<u>x</u>	Thermal treatment:		_ Conductive	·					
			_ Electrical F	Resistance					
		v	Steam	_ 3 phase	_	6 phase	AC po	wer D	C power
		<u>X</u>		Steam	_	Steam + air	Steam	+ O2	
.,	Time of Took	D:1.	Other (desc		1. 6				
<u>X</u>	Type of Test: <u>x</u>	Pilot			-scale Syst	em neous and permea	abla unaanaalir	datad aadimanta	
<u>x</u>	Geology of Treatment Zon	e.		- '		•		olidated sediments	
						·		ses of lower perme	
			<u>X</u>					ayers of higher per	•
						ctured bedrock (i.e			mousinty material
				-		k, limestone, sand	-	S.I.y	
	_ Treatment Targe Zone:		Saturated	_				Saturated and Vados	e zones)
	_ Start of Thermal Test:		_			-			
	_ Hydraulic Control		_ Yes	No			_		
<u>x</u>	Treatment Cell Design:								
	Size of target zone (ft2):				1250		1	Unknown (x ft)
	Thickness of target zone (ft):					1	Unknown	
	Depth to top of target zone	e (ft bg	ıs):				¹	Unknown	
	Thickness of target zone b	elow	water table ((ft):			1	Unknown	
	Number of energy delivery	point	s:		<u>4</u>		1	Unknown	
	Number of extraction point	ts:			<u>6</u>		1	Unknown	
	_Temperature Profile:								
	Initial formation temperatu	re (de	g C):					Unknow	'n
	Maximum representative for	ormati	on tempera	ture (deg C	C):			Unknow	'n
	Time to reach maximum re	eprese	ntative tem	perature (d	lays):			Unknow	'n
	Duration of treatment at re	prese	ntative temp	perature (da	ays):			Unknow	'n
						<u>Da</u>	<u>ite</u>	<u>Temperat</u>	ure (deg C)
	Formation temperature im-	media	tely post-tre	atment:					
	Formation temperature po			Ū	nt 1:	-		-	
	Duration of post-treatment	monit	oring (days)):					
	_ Mass of contaminant remo	ved:							
	Via	liquid	pumping:				lb	kg	Unknow
	In v	apor s	tream:				lb	kg	Unknow
	Tota	al:		_			lb	kg	Unknow
	Comments:								
	Attachments:								

and Performance					Facility ID#:	<u>1000</u>
_ Performance						
Remediation Goal:						
	In Groundwater: -					
	_					
	In Soil:					
Was the Remediation						
						
	Comment: —					
	_					
	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k	Whr/vd ³
	tal energy applied to t	reatment zone:	ĸ ‹‹ iii		 _ kWhr/m³	kWhr/yc
	ner energy:				_ kWhr/m ³	kWhr/yc
Oti					_ KVVNr/m ·	KVVNI/yd
	Please	note other energy:	-			-
Cost						
Total Project Cost:						
-	nsultant Cost:					
· 	ermal Vendor Cost:					
					d ³	
	ergy Cost:			m	_ yd³	
	ner Cost 1:					
	her Cost 2:					
	ner Cost 3:	-				
Please note of	ther cost:	Other Cost 1:				
	_	Other Cost 2:				

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD					Date:	11/6/2006
	Type of treatment:	Conductive	<u>X</u>	Steam	ERH	Other:		
	Type of Contaminant:	X Chlorinated Solv	vents		Petroleum Hydroc	arbons	Pesticide	es
		Wood Treating			Other:			
	Treatment Status:	Active	$\underline{\mathbf{X}}$	Post				
	Type of Test:	X Pilot Test		Full Scale	System			
	Start of Test:	<u>Aug-99</u>		End	of Test: 1-Sep		Duration: ~2	years !
	Type of Site:	X Non-DOD		_ DoD				
<u>X</u>	Facility Name: Muehlach	er Germany						
	Address:							
	City, State, Zip Code:	Muehlacher Germany						
	OU# or Site #:							
<u>X</u>	Primary point of contact:	Dr. Hans-Peter Koschi	itekv					
^		of Stuttgart	itsky					
	Address: Pfaffenwaldring	-						
	City, State, Zip Code:	Stuttgart, Germany						
		Stuttgart, Germany		amail: kas	ch@iws.uni-stuttgart	de		
	Tholic #.			cinari. <u>Ras</u>	en e i w s. um - stuttgart	<u>.uc</u>		
	Other contacts or vendors w	ho worked on site			None			
	Point of contact:							
	Type:Vendor, C	Consultant	_Ven	dor, Techni	cal Applications	Oth	ner	
	Organization:							
	Address:							
	City, State, Zip Code:							
	Phone #:		-	email:				
Q	A/QC							
	_ Characteristics of Interest	:						
	Good pre- and post-tre	atment groundwater dat	a		Good pre- a	nd post-treatme	nt soil data	
	Good temperature pro-	file vs. time information			Flux assessr	nent		
	Groundwater elevation	ns			Geologic cro	oss-section		
	Hydraulic Conductivit	y information						

<u>1010</u>

Ge	neral Site Ass	sessment Data					Facility ID	D#: <u>1010</u>
	Impacted 2	Impacted zone a	as defined by documentation	Width (ft): npacted zone (See source zo		ness (ft):	<u> </u>	Unknown
		Map attachment	t					
	Monitor W	/ells: Number of relevant n	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
		Number of wells relat	tive to treatment zone:	r to trouble				
		Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	_ Soil Boring	s: Number of relevant so	oil borings with pre-treatment	t data:				
		Number of relevant so	oil borings with post-treatmer	nt data:				
		Number inside treatme	ent zone:	Number outside	treatment zone:			
<u>X</u>	Types of C	ontaminants	1	1	T		T	
					Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	X Benzene		None	None	None	None
		trans-1,2-dichloroethene	X Tolune		None	None	None	None
		1,1-dichloroethane	X Ethylbenzene		None	None	None	None
		1,2-dichloroethane	X m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	X o-xylene		None	None	None	None
C	hemicals of Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
	Comme	nts:						
				-				
	Attachmen	ts:						
		-						

Нус	Irogeologic Conceptu	ual Model				Facility ID#:	<u>1010</u>					
<u>X</u>	Geology:	<u>Zone</u>	Unconsolida	ated Sediments								
		Vadose Zone:	Relativ	vely homogeneous	and permeable unconso	olidated sediments						
			Relativ	vely homogeneous	and impermeable uncor	solidated sediments						
			Largel	Largely permeable sediments with inter-bedded lenses of lower permeability material								
			Largel	Largely impermeable sediments with inter-bedded layers of higher permeability material								
			Comp	Competent, but fractured bedrock (i.e. crystalline rock)								
			\underline{X} Weathered bedrock, limestone, sandstone									
		Saturated Zone:	Relativ	Relatively homogeneous and permeable unconsolidated sediments								
			Relativ	Relatively homogeneous and impermeable unconsolidated sediments								
			Largel	Largely permeable sediments with inter-bedded lenses of lower permeability material								
			Largel	y impermeable sed	iments with inter-bedde	d layers of higher permeab	ility material					
			Comp	etent, but fractured	bedrock (i.e. crystalline	rock)						
			X Weath	ered bedrock, limes	stone, sandstone							
_	_ Ground surface ele	evation based on wells in	or adjacent to	treatment zone:	ft a	msl1	Unknown					
_	_ Aquifer Characteris											
	Is more than 1 aqu	ifer present?	No		:	Unknown (assume	single aquifer)					
			Aquifer	1 A	quifer 2 Ac	quifer 3						
	Depth to water:	low value (ft bgs):										
		high value (ft bgs):				<u></u> _						
		Unknown:										
	_ Flow direction											
	_ Flow direction											
	Horizontal hydrauli	ic gradient (feet/foot):				,	Unknown					
-	Vertical hydraulic	, ,					Unknown					
	vertical flydraulie g	gradient (rect/rect).					JIKHOWII					
	_ K range (ft/day)	Measure	ed using:	Slug Test	Laboratory	Field data						
	g. (,)	low	_	g			Unknown					
		high										
	Transmissivity (ft2/	_	ed using:	Slug Test	Laboratory	Field data						
	, , , ,	low		<u></u>			Unknown					
		high										
		··· g ··										
	Comments: _											
	_											
	_											

Attachments:

The	ermal Treatment - De	esign								Fac	ility ID#:	<u>1010</u>	
<u>X</u>	Thermal treatmen	ıt:		_ Condu	ctive								
				_ Electri	cal Resista	Resistance							
				•	3 ph	ase	6	ó phase	AC	power	Do	C power	
			<u>X</u>	Steam									
				-	Stea	m		Steam + air	Ste	am + O2			
				_ Other	(describe)								
<u>X</u>	Type of Test:	<u>X</u>	Pilo	t test		_ Full-scale	System						
<u>X</u>	Geology of Treatr	ment Zor	ne:		Rela	atively hon	nogeneou	is and permea	ble uncons	olidated sed	iments		
					Rela	atively hon	nogeneou	is and imperm	eable unco	nsolidated s	ediments		
					Larg	gely perme	able sed	iments with into	er-bedded	lenses of lov	ver perme	eability m	naterial
					Larg	gely imperi	meable s	ediments with i	inter-bedde	d layers of h	nigher per	meability	y material
					Con	npetent, bu	ut fracture	ed bedrock (i.e	. crystalline	rock)			
					<u>X</u> Wea	athered be	drock, lin	nestone, sands	stone				
<u>X</u>	Treatment Targe	Zone:		_ Satura	ated only	<u>X</u>	Vados	e only	Bot	h (Saturated a	and Vados	e zones)	
<u>X</u>	Start of Thermal	Γest:	Aug	<u>-99</u>				Duration:	~2 years				
<u>X</u>	Hydraulic Control		<u>X</u>	Yes		_ No							
<u>X</u>	Treatment Cell De	esign:											
	Size of target zon	e (ft2):				403	<u>86</u>			Unknown	(<u>66</u> x	<u>66</u> ft)
	Thickness of targe	et zone	(ft):			<u>26.</u>	2			Unknown			
	Depth to top of ta	rget zon	e (ft bo	gs):		<u>23</u>				Unknown			
	Thickness of targe	et zone l	below	water ta	ble (ft):	<u>0</u>				Unknown			
	Number of energy	deliver	y point	s:		<u>1</u>				Unknown			
	Number of extrac	tion poin	nts:			<u>6</u>				Unknown			
	.												
	_ Temperature Prof		/ مام	~ C\.							T.T1		
	Initial formation to	-				da a C).	-				_ Unknow		
	Maximum represe						-				_ Unknow		
	Time to reach ma				•		_			· <u></u>	_ Unknow		
	Duration of treatm	ient at re	eprese	ntative t	emperatu	ire (days):	-				_ Unknow	n	
								<u>Dat</u>	<u>:e</u>]	Temperati	ure (deg	<u>C)</u>
	Formation temper	rature im	nmedia	tely pos	t-treatme	nt:	_						
	Formation temper	rature po	ost-trea	atment n	nonitoring	event 1:	_						
	Duration of post-t	reatmen	t moni	toring (d	lays):		-						
V	Mana of contamin												
<u>X</u>	Mass of contamin			numnin	~ :		140		11.	V	l. a		Llalanous
			-	pumpin	g.		<u>140</u>		lb	<u>X</u>	kg		Unknow
		Tot		stream:			<u>2660</u>		lb	<u>X</u>	kg		Unknow
		101	tai:				2800		lb	<u>X</u>	kg	_	Unknowi
	Comments:												
	- -	Treated	appro	ximate	ly 3000 n	n3 (3924	<u>yd3)</u>						
	Attachments:												
	-												
	-												

Cos	st and Performance					Facility ID#:	<u>1010</u>
	_ Performance						
	Remediation Goal:						
		In Groundwater: -					
		In Soil:					
	Was the Remediation						
	_	_ In Groundwater _					
		Comment: -					
		_					
	_	In Soil					
		Comment: -					-
		_					
	General comments	on the thermal applica	ation:				
	Lessons Learned						
	F						
_	_ Energy			kWhr	14\A/la #/ma 3	144	المعرار بطاع
	Total Energy Used:			KWNr			
		al energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd ³
	Otr	ner energy:				_ kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
<u>X</u>	Cost						
	Total Project Cost:		950,900				
	•	nsultant Cost:					
	· <u></u>	ermal Vendor Cost:	290.81 / yd3				
		ergy Cost:	<u> 20010 : 7 yao</u>	n	n ³	_ yd³	
		ner Cost 1:		<u> </u>	·	_ ,~	
		ner Cost 1:					
							
	·	ner Cost 3:	Other Co-t 4:	<u> </u>			
	Please note ot	ner cost:	Other Cost 1:				
		_	Other Cost 2:				

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD						Date:	10/18/2006
	Type of treatment:	Conductive		_ Steam	<u>X</u>	ERH	Other:		
	Type of Contaminant:	Chlorinated Solv	ents	<u>X</u>	Petr	oleum Hydro	carbons	Pesticides	
		Wood Treating			Othe	er:			
	Treatment Status:	Active	$\underline{\mathbf{X}}$	Post					
	Type of Test:	Pilot Test	$\underline{\mathbf{X}}$	Full Scale	e Syste	m			
	Start of Test:	9/26/2001		End	of Test	t: <u>4/30/2002</u>		Duration: 217	<u>d</u>
	Type of Site:	X Non-DOD		_ DoD					
<u>X</u>	Facility Name: North Hill	Facility Name: North Hill Manor							
	Address:								_
	City, State, Zip Code:	Calgary, Alberta, Cana	<u>da</u>						
	OU# or Site #:								
<u>X</u>	Primary point of contact:	Randall Warren							
	Organization: Shell Cana	<u>ada</u>							
	Address:								
	City, State, Zip Code:								
	Phone #: 403-691-2954			email:					
<u>X</u>	Other contacts or vendors wh	ho worked on site				_ None			
	Point of contact: Gary Millard								
	Type:Vendor, ConsultantVendor, Technical ApplicationsOther								
	Organization: Shell Canada								
	Address:								
	City, State, Zip Code:								
	Phone #: 403-216-5558			email: gar	y.milla	rd@shell.com	<u>m</u>		
Q.	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	atment groundwater data	ı			_ Good pre-	and post-treatme	ent soil data	
	Good temperature prof	file vs. time information				_Flux assess	sment		
	Groundwater elevation	ıs				_ Geologic c	ross-section		
	Hydraulic Conductivit	y information							

1030

		as defined by documentation			ness (ft): <u>13.5</u>		Unknown				
	Map attachment	Alternative method for determining size of impacted zone (See source zone definition attachments) Man attachment									
		мар ацамител									
X Monitor V	Vells: Number of relevant r	Number of relevant monitoring wells with groundwater data:									
			Pre-treatment:	<u>5</u>	Post-treatment:	<u>15</u>					
		tive to treatment zone:									
	Pre-treatment	In: <u>5</u>	Upgradient:	Downgradient:		ssgradient:					
	Post-treatment	In: <u>15</u>	Upgradient:	Downgradient:	Cro	ssgradient:					
X Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data: <u>22</u>								
	Number of relevant so	borings with post-treatment data: 2									
	Number inside treatm	ent zone:	_ Number outside	treatment zone:							
X Types of C	Contaminants		T	1		1					
				Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:				
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	Trichloroethene	Hexane	Creosote	None	None	None	None				
	Tetrachloroethene	Jet Fuel		None	None	None	None				
	1,1-dichloroethene	Napthalene		None	None	None	None				
	cis-1,2-dichloroethene	X Benzene		0.1 mg/L	1 mg/kg	0.001 mg/L	0.01 mg/kg				
	trans-1,2-dichloroethene	X Tolune		0.01 mg/L	0.5 mg/kg	0.001 mg/L	0.1 mg/kg				
	1,1-dichloroethane	X Ethylbenzene		0.05 mg/L	5 mg/kg	0.001 mg/L	0.1 mg/kg				
	1,2-dichloroethane	X m/p-xylene		None	None	None	None				
Chemicals of	1,1,1-trichloroethane	X o-xylene		None	None	None	None				
Concern	1,1,2-trichloroethane	X xylenes		0.1 mg/L	5 mg/kg	0.001 mg/L	0.1 mg/kg				
	1,1,2,2-tetrachloroethane	X TPH		1 mg/L	500 mg/kg	0.1 mg/L	10 mg/kg				
	Vinyl Chloride			None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
Comme	nts:										
Attachmer	nts:										

1030

General Site Assessment Data

Hyd	rogeologic Conceptual I	Model		Facility ID#:	<u>1030</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sedi Relatively homogeneous and impermeable unconsolidated sedi Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of h Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sedi X Relatively homogeneous and impermeable unconsolidated sedi Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of h Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ediments ver permeability material nigher permeability mater iments ediments ver permeability material	rial
<u>X</u>	Ground surface eleva	tion based on wells in o	or adjacent to treatment zone: ft amsl	X Unknown	
X	Aquifer Characteristic Is more than 1 aquifer Depth to water:		No Yes (number): X Unline Aquifer 1 Aquifer 2 Aquifer 3 14.1 16.7	known (assume single aqui	fer)
<u>X</u>	Flow direction		<u>West</u>		
X	Horizontal hydraulic g	, ,		<u>X</u> Unknown<u>X</u> Unknown	
X	K range (ft/day) Transmissivity (ft2/day)	Measured low high /): Measured low		Field data X Unknown Field data Unknown	
		high		CHKBOWN	

Comments:

Attachments:

k=10e-6 cm/s

The	ermal Treatment - Design									Facility ID#:	<u>1030</u>
<u>X</u>	Thermal treatment:		Cond	uctive							
		<u>X</u>	Electr	rical Resistance	-						
				3 phase	_	6 pha	ise		AC power	DC	power
			_ Steam	ı							
				Steam	-	Stear	n + air		Steam + O2		
			_ Other	(describe)							
<u>X</u>	Type of Test:	Pilot	test	<u>X</u> Fu	ll-scale Sys	tem					
<u>X</u>	Geology of Treatment Zo	ne:		Relative	ly homoge	eneous ar	nd permeat	ole und	consolidated	sediments	
				X Relative	ly homoge	eneous ar	nd imperme	eable u	unconsolidat	ed sediments	
				Largely	permeable	e sedimer	nts with inte	er-bed	ded lenses d	f lower permea	ability material
				Largely	impermea	ble sedin	nents with i	nter-be	edded layers	of higher perr	meability material
				Compet	ent, but fra	actured b	edrock (i.e.	crysta	alline rock)		
				Weather	red bedroo	k, limest	one, sands	tone			
<u>X</u>	Treatment Targe Zone:		Satur	rated only	v	adose onl	y	<u>X</u>	Both (Satura	ted and Vadose	zones)
<u>X</u>	Start of Thermal Test:	9/26/	/2001				Duration:	217 c	<u>l</u>		
<u>X</u>	Hydraulic Control	<u>X</u>	Yes	No)						
<u>X</u>	Treatment Cell Design:										
	Size of target zone (ft2):				4000				Unkno	own (_ x ft)
	Thickness of target zone	(ft):			<u>13</u>				Unkno	own	
	Depth to top of target zon	e (ft bg	s):		<u>8</u>				Unkno	own	
	Thickness of target zone	below v	vater ta	able (ft):	<u>5</u>				Unkno	own	
	Number of energy deliver	y points	s:		<u>10</u>				Unkno	own	
	Number of extraction poir	nts:			<u>35</u>				Unkno	own	
<u>x</u>	Temperature Profile:										
	Initial formation temperate	ure (deg	g C):							Unknown	1
	Maximum representative			perature (deg	C):	<u>78</u>				Unknown	1
	Time to reach maximum i	represe	ntative	temperature (days):					Unknown	1
	Duration of treatment at representative temperature (day									Unknown	ı
							Date	Э		Temperatu	re (dea C)
	Formation temperature in	nmediat	ely po	st-treatment:				_			
	Formation temperature po				ent 1:						<u>.</u>
	Duration of post-treatmen			ū							
<u>X</u>	Mass of contaminant rem	oved:									
_		a liquid i	pumpir	ng:					lb	kg	Unknow
		vapor s		_	1740) Liters			='	kg	Unknow
		tal:		_		, 1311019			_lb	kg	Unknow
	Comments:										
	<u>15 vapo</u>	or extra	ction v	wells and 20	groundwa	iter extra	ction wells	<u>s</u>			
	Attachments:										

Cost	and Performanc	е					Facility ID#:	<u>1030</u>
X	Performance							
	Remediation Go	al:						
		X	In Groundwater:					
				Benzene-0.4m	Alberta, Canada g/L, toluene-25mg	a Tier 1 - <5 ppb g/L, ethylbenzene		s-80mg/L
		XX	In Soil:	·	-	- -		
			Benzene	e-0.2mg/Kg, toluene-4	0mg/Kg, ehtylben	zene-300mg/Kg.	xylene-110mg/K	g, TPH-2000mg/Ko
	Was the Remed	liatior	n Goal Achieved:					
		<u>X</u>	In Groundwater					
			Comment:					
			Yes	<u>S</u>				
		<u>X</u>	In Soil					
			Comment:					
			Yes	<u>s</u>				
	Conoral commo	nto o	n the thermal applicat	ion				
		1115 0	п пе петпа аррісат					
								
	Lessons Learne	d						
	_ Energy							
	Total Energy Us				kWhr	kWhr/m ³		
			al energy applied to tre	eatment zone:			kWhr/m ³	kWhr/yd ³
		Oth	er energy:	_			kWhr/m ³	kWhr/yd ³
			Please n	ote other energy:				_
	Cost							
	Total Project Co	et.						
	rotar rojour ou		sultant Cost:					
		_	rmal Vendor Cost:					
	-		rgy Cost:			m^3	yd ³	
			er Cost 1:	-		_'''	yu	
			er Cost 1: er Cost 2:					
			er Cost 2: er Cost 3:					
	Please no	=		Other Cost 1:				
	F lease 110	ເອ ບເເ		Other Cost 2:				

____ Other Cost 3:

<u>X</u>	File Analyzed By: JT	<u>X</u> PD			Date:	10/18/2006			
	Type of treatment:	Conductive	Steam	X ERHOther:					
	Type of Contaminant:	Chlorinated Solv	vents <u>X</u>	Petroleum Hydrocarbons	Pesticides				
		Wood Treating		Other:					
	Treatment Status:	Active	X Post						
	Type of Test:	Pilot Test	Full Scale	e System					
	Start of Test:	8/14/2003	End	of Test: <u>3/xx/04</u>	Duration:				
	Type of Site:	X Non-DOD	DoD						
<u>X</u>	Facility Name: Rosslyn Turbo								
	Address:					_			
	City, State, Zip Code:	Edmonton, Canada							
	OU# or Site #:					_			
<u>X</u>	Primary point of contact:	Randall Warren							
		ada Products, Ltd.							
	City, State, Zip Code:								
	Phone #: 403-691-2954		email:						
<u>X</u>	Other contacts or vendors wh	ho worked on site		None					
	Point of contact: Gary	y Millard							
	Type: Vendor, C	onsultant	_ Vendor, Techni	ical Applications	Other				
	Organization: Shell Cana	ada Products, Ltd.							
	Address:								
	City, State, Zip Code:								
	Phone #: 403-216-5558	403-560-4340	email: gar	y.millard@shell.com					
Q	A/QC								
	_ Characteristics of Interest								
	Good pre- and post-tre	atment groundwater data	a	Good pre- and post-treat	ment soil data				
	Good temperature prof	file vs. time information		Flux assessment					
	Groundwater elevation	ns		Geologic cross-section					
	Hydraulic Conductivity	y information							

1040

General Site As	sessment Data					Facility II	D#: <u>1040</u>			
V	Zener Levelle (e eschelate (le	or dispation (fr.)	ME dil. 760	Thirds	(6)		77.1			
X Impacted	- "	w direction)(ft.): see below	Width (ft):	I nickn	ess (ft):	_	Unknown			
	- -	as defined by documentation								
	Alternative method for determining size of impacted zone (See source zone definition attachments)									
	Map attachmen	t								
Monitor V	Wells: Number of relevant r	monitoring wells with ground	water data:				None			
			Pre-treatment:		Post-treatment:		_			
	Number of wells rela	tive to treatment zone:								
	Pre-treatment	In:	Upgradient:	Downgradient: _	Cros	ssgradient:				
	Post-treatment	In:	Upgradient:	Downgradient: _	Cros	ssgradient:				
0 " 0 .										
Soil Boring	=	oil borings with pre-treatmen								
		oil borings with post-treatmen								
	Number inside treatm	ent zone:	_ Number outside	treatment zone:						
· - ·										
X Types of 0	Contaminants									
				Average Pre-treatmer Chemi			ent Concentration per nical:			
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
	Trichloroethene	Hexane	Creosote	None	None	None	None			
	Tetrachloroethene	Jet Fuel		None	None	None	None			
	1,1-dichloroethene	Napthalene		None	None	None	None			
	cis-1,2-dichloroethene	X Benzene		None	None	None	None			
	trans-1,2-dichloroethene	X Tolune		None	None	None	None			
	1,1-dichloroethane	X Ethylbenzene		None	None	None	None			
	1,2-dichloroethane	X m/p-xylene		None	None	None	None			
	1,1,1-trichloroethane	X o-xylene		None	None	None	None			
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None			
	1,1,2,2-tetrachloroethane			None	None	None	None			
	Vinyl Chloride			None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
Comme	ents:									
	Impacted area of 1500 m3									
Attachmer	nts:									

Hyd	rogeologic Conceptu	al Model					Facility ID#:	<u>1040</u>
X	Geology:	Zone Vadose Zone: Saturated Zone:	Relati Large Comp Weath Relati Relati Large Large Large Comp	vely homogeneously permeable sed by impermeable sed teent, but fracture tered bedrock, lire vely homogeneously permeable sed by impermeable sed teent, but fracture	ediments with inter- ed bedrock (i.e. crys- nestone, sandstone us and permeable us us and impermeable iments with inter-be-	e unconsolidated edded lenses of -bedded layers of stalline rock) inconsolidated se unconsolidated se unconsolidated lenses of -bedded layers of stalline rock)	d sediments lower permeability ma of higher permeability is sediments	material terial
	_ Ground surface ele	vation based on wells in o				ft amsl	Unkn	own
X	Aquifer Characteris Is more than 1 aqui Depth to water:		No Aquifer	Yes (numb	Aquifer 2	<u>X</u> Aquifer 3	Unknown (assume single	e aquifer)
	_ Flow direction						_	
	_ Horizontal hydraulic	c gradient (feet/foot): radient (feet/foot):					Unkn	
	_ K range (ft/day)	Measured low	using:	Slug Test	Laborato	ory	Field data Unkn	own
	Transmissivity (ft2/	high day): Measured low high	using:	Slug Test	Laborato	ory	Field data Unkn	own
	Comments:							
	Attachments:	=10E-6 cm/s						

The	rmal Treatment - Design							F	acility ID#:	<u>1040</u>
<u>X</u>	Thermal treatment:		_ Conductive							
		<u>X</u>	Electrical R	esistance						
				3 phase		6 phase		AC power	DC	power
			_ Steam							
				Steam		Steam + air		Steam + O2		
			Other (descr							
	Type of Test:	_ Pilot		Full-	-					
<u>X</u>	Geology of Treatment Zone	э:				eneous and permea				
			X	,		eneous and imperm				ability material
			-			le sediments with int able sediments with			-	-
						ractured bedrock (i.e			or riigher pen	neability material
						ock, limestone, sands		amirio roony		
<u>X</u>	Treatment Targe Zone:					Vadose only	X	Both (Saturat	ed and Vadose	zones)
	_ Start of Thermal Test:					Duration:	:			
	_ Hydraulic Control		_Yes	No						
<u>X</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>3000</u>			Unknow	wn (_ x ft)
	Thickness of target zone (f	t):			<u>18</u>			Unknow	wn	
	Depth to top of target zone	(ft bg	js):		0			Unknow	wn	
	Thickness of target zone be			ft):	<u>5</u>			Unknow		
	Number of energy delivery		s:		<u>10</u>			Unknow		
	Number of extraction points	s:			<u>5</u>			Unknow	wn	
	_ Temperature Profile:									
-	_ remperature Frome. Initial formation temperatur	e (de	a C).						Unknown	
	Maximum representative for			ure (dea C	.).				Unknown	
	Time to reach maximum re		•						Unknown	
	Duration of treatment at rep	-	•						Unknown	
					., -,.					
						<u>Dat</u>	<u>te</u>		Temperatu	re (deg C)
	Formation temperature imp	nedia	tely post-trea	atment:						
	Formation temperature pos	st-trea	atment monite	oring even	t 1:					
	Duration of post-treatment	monit	toring (days)	:						
	_ Mass of contaminant remove	ved:								
	Via I	iquid	pumping:					lb _	kg	Unknown
			stream:	-			-		kg	Unknown
	Tota	ıl:						_ lb	kg	Unknown
	Comments									
	Comments:									
	Attachments:									

Cost and Performance Facility ID#: 1040

Performance					
Remediation Goal:					
<u>X</u> I	n Groundwater:				
		Albe	rta, Canada Tier 1	remediation - <5 pp	<u>b benzene</u>
!	n Soil:				
Was the Remediation 0					
!					
	Comment: -				
	_				
!	n Soil				
	Comment: -				
	_				
Canaral comments on	the thermal applied	ation:			
General comments on	те тетпагаррііса	auon.			
Lessons Learned					
Energy					
Total Energy Used:			kWhr	kWhr/m ³	
Total	energy applied to tr	reatment zone:		k\	Vhr/m ³ kWhr/yo
Other	energy:	_		k\	Vhr/m ³ kWhr/yo
	Please	note other energy:			
Cost					
Total Project Cost:					
Consu	ıltant Cost:				
Therm	nal Vendor Cost:				
Energ	y Cost:			_ m³ yo	3
Other	Cost 1:				
	Cost 2:				
Other					
Please note other		Other Cost 1:			
i lease flote offiel					
	_	Other Cost 2:			
		Other Cost 3:			

<u>x</u>	File Analyzed By: JT	<u>x</u> PD						Date:	10/30/2006
	Type of treatment:	Conductive		Steam	ERH	<u>x</u>	Other:	RFH	
	Type of Contaminant:	Chlorinated Solv	ents		Petroleum Hy		ons	Pesticides	
	,,	Wood Treating			Other:				
	Treatment Status:	Active	<u>x</u>	Post					
	Type of Test:	<u>x</u> Pilot Test		Full Scale	e System				
	Start of Test:	<u>1990</u>		End	of Test:			Duration:	
	Type of Site:	Non-DOD	<u>x</u>	DoD					
<u>x</u>	Facility Name: East Coast	t Naval Shipyard							
	Address:								_
	City, State, Zip Code:								
	OU# or Site #:								
	_ Primary point of contact:								_
	Organization:								_
	Address:								
	City, State, Zip Code:								_
	Phone #:			email:					_
	Other contacts or vendors w	ho worked on site			None				
	Point of contact:								
	Type:Vendor, C	Consultant	_Ven	ndor, Techni	cal Applications		Oth	ner	
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:			email:					
^	A/QC								
Q,	A/QC								
	_ Characteristics of Interest	t							
	Good pre- and post-tre	eatment groundwater data	ι		Good pr	e- and p	ost-treatme	nt soil data	
	Good temperature prof	file vs. time information			Flux ass	sessment			
	Groundwater elevation	ns			Geologi	c cross-s	section		
	Hydraulic Conductivit	ty information							

1050

General Site A	ssessment Data					Facility II	D#: <u>1050</u>
Impacted	5 "		Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
		=	npacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor	Wells: Number of relevant n	nonitoring wells with grounds			Deat to atmost		None
	Number of wells relat	tive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	· · · · · · · · · · · · · · · · · · ·	Upgradient:	Downgradient:		ssgradient:	
				g			
Soil Borin	igs: Number of relevant so	oil borings with pre-treatment	data:				
		oil borings with post-treatmer					
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
Types of	Contaminants						
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Commo	ents:						
Continu							
	-						
Attachme	nts:						

Hydrogeologic Conceptua	I Model		Facility ID#: 1050
Hydrogeologic Conceptua Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated segments with inter-bedded lenses of legactively impermeable sediments with inter-bedded lenses of legactively impermeable sediments with inter-bedded layers of legactively impermeable sediments with inter-bedded layers of legactively impermeable sediments with inter-bedded layers of legactively homogeneous and permeable unconsolidated segments largely permeable sediments with inter-bedded lenses of legactively impermeable sediments with inter-bedded layers of legactively impermeable sediments with layers of legactiv	ediments sediments ower permeability material f higher permeability material ediments sediments sediments ower permeability material
Ground surface elev Aquifer Characteristi	ics:	Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl No Yes (number): U Aquifer 1 Aquifer 2 Aquifer 3	Unknown Jnknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:		- - -
Flow direction			-
Horizontal hydraulic Vertical hydraulic gra			Unknown
K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data Unknown
Transmissivity (ft2/da	high	using:Slug TestLaboratory	Field data Unknown
Comments:			
Attachments:			

The	ermal Treatment - Design					Facility ID#:	<u>1050</u>
<u>x</u>	Thermal treatment:	Conductive					
		Electrical Resistan	ice				
		3 phas	se	6 phase	AC power	DC	power
	-	Steam					
		Steam		Steam + air	Steam + C	02	
	2	X Other (describe)	<u>RFH</u>				
<u>x</u>	Type of Test: <u>x</u> I	Pilot test	Full-scale Syst	em			
	_ Geology of Treatment Zone:	Relati	ively homoge	neous and permeal	ole unconsolidate	ed sediments	
		Relati	ively homoge	neous and imperme	eable unconsolid	ated sediments	
		_		sediments with inte		•	-
				ole sediments with i			neability material
				ctured bedrock (i.e.			
		·		k, limestone, sands			
	_	Saturated only	V:	adose only		urated and Vadose	zones)
	_ Start of Thermal Test:			Duration:			
	_ Hydraulic Control	Yes	No				
	Treetment Cell Designs						
	_ Treatment Cell Design:				I I a l		(4)
	Size of target zone (ft2): Thickness of target zone (ft):				<u> </u>	known (_ x ft)
	Depth to top of target zone (if).				<u> </u>	cnown	
	Thickness of target zone belo	- '			Unk		
	Number of energy delivery po					cnown	
	Number of extraction points:				· <u> </u>	cnown	
	_ Temperature Profile:						
	Initial formation temperature	(deg C):				Unknown	
	Maximum representative forr	mation temperature (de	eg C):			Unknown	
	Time to reach maximum repr	resentative temperatur	e (days):			Unknown	
	Duration of treatment at repre	esentative temperature	e (days):			Unknown	
				Date	<u>e</u>	Temperatu	re (deg C)
	Formation temperature imme	ediately post-treatment	ι:				
	Formation temperature post-	treatment monitoring e	event 1:			-	
	Duration of post-treatment m	onitoring (days):					
	_ Mass of contaminant remove	ed:					
	Via liq	luid pumping:			lb	kg	Unknow
	In vap	oor stream:			lb	kg	Unknow
	Total:				lb	kg	Unknow
	Comments:						
	Attachments:						

t and Performance					Facility ID#:	<u>1050</u>
_ Performance						
Remediation Goal:	_					
In	Groundwater: -					
	-					
In	Soil:					
· 						
Was the Remediation Go						
In	Groundwater _					
	Comment: —					
	_					
In	Soil					
	Comment: —					
	_					
General comments on th	e thermal applica	ation:				
						
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	k\	Vhr/yd ³
	nergy applied to t	reatment zone:			kWhr/m ³	kWhr/
Other e					kWhr/m³	kWhr/
		note other energy:		_	_	
Cost						
Total Project Cost:						
Consult	ant Cost:					
Therma	l Vendor Cost:					
Energy	Cost:			m³	yd³	
Other C				_	=	
Other C						
Other C						
Please note other of		Other Cost 1:				
i loase note otilei t		Other Cost 1:				
		Other Cost 2:				

Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u>	PD					Date:	11/16/2006
	Type of treatment:	<u>x</u>	Conductive		Steam	ERH	Other:		
	Type of Contaminant:	<u>x</u>	Chlorinated Sol	vents	<u>x</u>	Petroleum Hydrocar	bons	Pesticides	
			_Wood Treating			Other:			
	Treatment Status:		_Active	<u>x</u>	Post				
	Type of Test:	<u>x</u>	Pilot Test		Full Scale	e System			
	Start of Test:	12/5	/2005		End	of Test: <u>1/10/2006</u>		Duration: 36 d	
	Type of Site:	<u>x</u>	Non-DOD		_DoD				
<u>x</u>	Facility Name: <u>UK Atomi</u>	c Ene	rgy Authority's H	arwell s	Site				
	Address:								_
	City, State, Zip Code:	Oxfo	ordshire, England						
	OU# or Site #: Western st	orage	area						
<u> </u>	Primary point of contact:	Stev	e Langford						
	Organization: AIG Engir	eering	g Group						
	Address: 9 Kingsdale Bus	iness	Centre Regina	Road	Chelmsf	ord Essex CM1 1P	<u>E</u>		
	City, State, Zip Code:								
	Phone #: 01245 505 601				email: stev	ve.langford@aig.com			
	Other contacts or vendors wh	o wo	ked on site			None			
	Point of contact:								
	Type: Vendor, C	onsult	ant	Vend	dor, Techni	cal Applications	Otl	ner	
	Organization:								
	Address:								
	City, State, Zip Code:								
	Phone #:			-	email:				
_	N/00								
Q,	A/QC								
	_Characteristics of Interest								
	Good pre- and post-tre	atmen	t groundwater dat	ta		Good pre- and	l post-treatme	ent soil data	
	Good temperature prof	ïle vs.	time information	ı		Flux assessme	ent		
	Groundwater elevation	S				Geologic cros	s-section		
	Hydraulic Conductivit	y info	rmation						

<u>1060</u>

x Impacted			Width (ft):	Thickr	ness (ft):		<u>x</u> Unknown
		as defined by documentation					
		od for determining size of im	pacted zone (See source	zone definition attachmen	ts)		
	Map attachment						
<u>x</u> Monitor V	Wells: Number of relevant m	nonitoring wells with groundy	vater data:				None
			Pre-treatmer	it: <u>1</u>	Post-treatment:		
	Number of wells relat	ive to treatment zone:					
	Pre-treatment	In: <u>1</u>	Upgradient:	Downgradient:		ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
x Soil Boring	gs: Number of relevant so	il borings with pre-treatment	data:	Ĺ			
	Number of relevant so	il borings with post-treatmen	t data:				
	Number inside treatme	ent zone: 1	Number outs	de treatment zone:			
x Types of 0	Contaminants						
				Average Pre-treatme			ent Concentration per nical:
h	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	0.1 mg/L	None	None	None
	x Tetrachloroethene	Jet Fuel		0.01 mg/L	None	None	None
	x 1,1-dichloroethene	Napthalene		0.005 mg/L	None	None	None
	x cis-1,2-dichloroethene	Benzene		0.05 mg/L	None	None	None
	trans-1,2-dichloroethene	x Tolune		0.1 mg/L	None	None	None
-	x 1,1-dichloroethane	Ethylbenzene		0.01 mg/L	None	None	None
	x 1,2-dichloroethane	m/p-xylene		0.05 mg/L	None	None	None
Chemicals of	x 1,1,1-trichloroethane	o-xylene		0.1 mg/L	None	None	None
Concern	1,1,2-trichloroethane	x Benzene		0.01 mg/L	None	None	None
	x 1,1,2,2-tetrachloroethane			0.05 mg/L	None	None	None
	Vinyl Chloride	x <u>m/p-xylene</u>		0.05 mg/L	None	None	None
		x Ethylbenzene		0.1 mg/L	None	None	None
	x chloroform			0.5 mg/L	None	None	None
	<u>x</u> <u>dichloromethane</u>			0.1 mg/L	None	None	None
		x <u>o-xylene</u>		0.01 mg/L	None	None	None
		x <u>12-dichlorobenzene</u>		0.05 mg/L	None	None	None
		Napthalene		0.005 mg/L	None	None	None
Comme	ents:						
		_	·				
Attachmer	nts:						

1060

General Site Assessment Data

X	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sediments							
			Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone							
	_ Ground surface eleva	tion based on wells in o	r adjacent to treatment zone: ft amsl Unknown							
<u>x</u>	Aquifer Characteristic	s:								
_	Is more than 1 aquifer		No Yes (number): Yes (number) Yes (number)							
			Aquifer 1 Aquifer 2 Aquifer 3							
	Depth to water:	low value (ft bgs):	16.4							
		high value (ft bgs):	75.5							
		Unknown:								
<u>x</u>	Flow direction		<u>below</u>							
	_ Horizontal hydraulic g	radient (feet/foot):	Unknown							
	Vertical hydraulic grad		Unknown							
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,								
<u>x</u>	K range (ft/day)	Measured low high	using: Slug Test Laboratory Field data Unknown							
	Transmissivity (ft2/day	•	using:Slug TestLaboratoryField data							
		low	6458 Unknown							
		high								
		· ·								
	Comments:									
	Flov	v direction for high arc	oundwater levels - N to NE for low groundwater levels - E to SE							
	Attachments:									

1060

Hydrogeologic Conceptual Model

The	rmal Treatment - Design								Facility ID#:	<u>1060</u>
<u>x</u>	Thermal treatment:	<u>x</u> (Conductive							
		F	Electrical R	tesistance						
				3 phase	_	6 phase		AC power	DC	power
		S	Steam							
				Steam	_	Steam + air		Steam + O2	2	
			Other (desc	ribe)						
<u>x</u>	Type of Test: <u>x</u>	Pilot te	st	Full-	scale Sys	em				
<u>x</u>	Geology of Treatment Zone):		Relatively	homoge	neous and per	meable u	nconsolidated	d sediments	
			-		•	neous and imp				
									of lower permea	-
					-			-	s of higher pern	neability material
				-		ctured bedrock	-			
		_	<u>X</u>			k, limestone, sa	andstone			
<u>X</u>	Treatment Targe Zone:		Saturated	only	<u>x</u> V	adose only			ated and Vadose	zones)
<u>X</u>	Start of Thermal Test:	12/5/20				Dura	tion: <u>36d</u>	<u>l</u>		
	_ Hydraulic Control	— ,	l'es	No						
v	Treatment Cell Design:									
<u>x</u>	Size of target zone (ft2):				30			Unkn	oven (x ft)
	Thickness of target zone (ft	١٠			30 46			Unkn		x ft)
		,			16			Unkn		
	Depth to top of target zone Thickness of target zone be			f+\·	0			Unkn		
	Number of energy delivery		tei table (11).	<u>u</u> 3			Unkn		
	Number of extraction points				<u>s</u> 1			Unkn		
	Number of extraction points				±				lowii	
<u>x</u>	Temperature Profile:									
_	Initial formation temperature	e (deg C	C):						Unknown	
	Maximum representative fo	rmation	temperat	ure (deg C):	<u>90</u>			Unknown	
	Time to reach maximum rep	oresenta	ative temp	perature (da	ays):	<u>60</u>			Unknown	
	Duration of treatment at rep	resenta	ative temp	erature (da	ys):	<u>1</u>			Unknown	
							<u>Date</u>		Temperatur	e (deg C)
	Formation temperature imm	nediatel	y post-trea	atment:						
	Formation temperature pos	t-treatm	ent monit	oring event	t 1 :					
	Duration of post-treatment r	monitori	ing (days)	:						
<u>x</u>	Mass of contaminant remov									
		quid pu						lb	kg	Unknown
		por stre	eam:	-				lb	kg	Unknown
	Total	l:			2	<u>14</u>	_	lb	<u>x</u> kg	Unknown
	Comments:									
		mo +=-	otod 25	عادی	otor= (4	e valo 4040 ti	12)			
	<u>I otal volu</u>	ime tre	ated - 35	.∠ cubic m	eters (4	6 yd3, 1243 fi	(3)	2.5 m spac	ing of heater w	vells (16 ft)
	Attachments:									

Cost and Performance			Facility ID#:	<u>1060</u>
Performance				
Remediation Goal:				
In Groundwa	ater:			
In Soil: -				
<u></u>				
Was the Remediation Goal Achieve				
In Groundwa	ater			
Comm	ent:			
In Soil				
Comm	ent:			
General comments on the thermal	application:			
Objective: reduce mass of \//	OCs in unsaturated zone in the	source area to the ext	ant economically feasible re	eulting in a
diminshing flux of mass to gro		s source area to the exte	ent economically reasible re	esulung in a
Lessons Learned				
Energy				
Total Energy Used:		kWhr	_ kWhr/m³ kV	Vhr/vd ³
Total energy appli	ed to treatment zone.		kWhr/m ³	kWhr/yd ³
Other energy:			kWhr/m ³	kWhr/yd ³
	Please note other energy:			,yd
<u> </u>	iodoo noto otnor onorgy.			
Cost				
Total Project Cost:				
Consultant Cost:				
Thermal Vendor C	Cost:			
Energy Cost:		m ³	yd ³	
Other Cost 1:				
Other Cost 2:				
Other Cost 3:				
Please note other cost:	Other Cost 1:			
	Other Cost 2:			
	Other Cost 3:			

Address: City, State, Zip Code: Czech Republic OU# or Site #: Primary point of contact: Pavel Dusilek Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz	<u>x</u>	File Analyzed By: JT	<u>x</u> PD				Date:	10/26/200
		Type of treatment:	Conductive	x Steam	ERH	Other:		
Treatment Status:Active _ x Post Type of Test:Pilot Test		Type of Contaminant:	<u>x</u> Chlorinated Sol	vents _	Petroleum Hydr	ocarbons	Pesticio	les
Type of Test:Pilot Test			Wood Treating	_	Other:			
Start of Test:		Treatment Status:	Active	$\underline{\mathbf{x}}$ Post				
Type of Site: x Non-DODDoD Facility Name: Prague, Czech Address: City, State, Zip Code: Czech Republic OU# or Site #: Primary point of contact: Pavel Dusilek Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on siteNone Point of contact: Petr Kvapil Type: x Vendor, ConsultantVendor, Technical ApplicationsOther Organization: AQUATEST Address: City, State, Zip Code:		• •	Pilot Test	x Full Sca	le System			
Facility Name: Prague, Czech Address: City, State, Zip Code: Czech Republic OU# or Site #: Primary point of contact: Pavel Dusilek Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on site None Point of contact: Petr Kvapil Type: X Vendor, Consultant Vendor, Technical Applications Other Organization: AQUATEST Address: City, State, Zip Code:		Start of Test:	<u>Jan-01</u>	En	d of Test:		Duration: 3	monts
Address: City, State, Zip Code: Czech Republic OU# or Site #: Primary point of contact: Pavel Dusilek Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on site Point of contact: Petr Kvapil Type: Y Vendor, Consultant Vendor, Technical Applications Other Organization: AQUATEST Address: City, State, Zip Code:		Type of Site:	x Non-DOD	DoD				
City, State, Zip Code: Czech Republic OU# or Site #: Primary point of contact: Pavel Dusilek Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on siteNone Point of contact: Petr Kvapil Type: x Vendor, ConsultantVendor, Technical ApplicationsOther Organization: AQUATEST Address: City, State, Zip Code:	<u>x</u>	Facility Name: <u>Prague, C</u>	<u>Czech</u>					
OU# or Site #: Primary point of contact: Pavel Dusilek Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on siteNone Point of contact: Petr Kvapil Type: X Vendor, ConsultantVendor, Technical ApplicationsOther Organization: AQUATEST Address: City, State, Zip Code:		Address:						
Primary point of contact: Pavel Dusilek Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on siteNone Point of contact: Petr Kvapil Type: X Vendor, ConsultantVendor, Technical ApplicationsOther Organization: AQUATEST Address: City, State, Zip Code:		City, State, Zip Code:	Czech Republic					
Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on siteNone Point of contact: Petr Kvapil Type: X Vendor, ConsultantVendor, Technical ApplicationsOther Organization: AQUATEST Address: City, State, Zip Code:		OU# or Site #:						
Organization: AQUATEST Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on site None Point of contact: Petr Kvapil Type: X Vendor, Consultant Vendor, Technical Applications Other Organization: AQUATEST Address: City, State, Zip Code:								
Address: City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on siteNone Point of contact: Petr Kvapil Type: x Vendor, ConsultantVendor, Technical ApplicationsOther Organization: AQUATEST Address: City, State, Zip Code:	<u> </u>							
City, State, Zip Code: Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on site None Point of contact: Petr Kvapil Type: x Vendor, Consultant Vendor, Technical Applications Other Organization: AQUATEST Address: City, State, Zip Code:		• ===	<u>EST</u>					
Phone #: 420 234 607 151 email: dusilek@aquatest.cz Other contacts or vendors who worked on siteNone Point of contact: Petr Kvapil Type: x Vendor, ConsultantVendor, Technical ApplicationsOther Organization: AQUATEST Address: City, State, Zip Code:								
Other contacts or vendors who worked on site None Point of contact: Petr Kvapil Type: X Vendor, Consultant Vendor, Technical Applications Other Organization: AQUATEST Address: City, State, Zip Code:								
Point of contact: Petr Kvapil Type: X Vendor, Consultant Vendor, Technical Applications Other Organization: AQUATEST Address: City, State, Zip Code:		Phone #: 420 234 607 15	<u>1</u>	email: <u>du</u>	silek@aquatest.cz			
Type: x Vendor, Consultant Vendor, Technical Applications Other Organization: AQUATEST Address: City, State, Zip Code:	<u>x</u>	Other contacts or vendors w	ho worked on site		None			
Organization: AQUATEST Address: City, State, Zip Code:		Point of contact: Pet	r Kvapil					
Address: City, State, Zip Code:		Type: <u>x</u> Vendor, 0	Consultant	Vendor, Tech	nical Applications	Othe	er	
City, State, Zip Code:		Organization: <u>AQUATE</u>	<u>EST</u>					
		Address:						
Phone #: 420 485 152 652 email: kvapil@aquatest.cz		City, State, Zip Code:						
		Phone #: <u>420 485 152 65</u>	2	email: <u>kv</u>	apil@aquatest.cz			
		Characteristics of Interes	+					
		_		ta	Good pro	and nost transmon	it soil data	
Characteristics of Interest Good pre- and post treatment groundwater data Good pre- and post treatment groundwater data Good pre- and post treatment soil data			-			•	u son uata	
Characteristics of InterestGood pre- and post-treatment groundwater dataGood pre- and post-treatment soil data		Good temperature pro	ane vs. ume miormation	1	riux asses	SHICH		
Characteristics of Interest		Groundwister alassetis	ne.		Coologia	aross soation		

<u>1070</u>

G	eneral Site As	sessment Data					Facility II	D#: <u>1070</u>
_	Impacted	= "	flow direction)(ft.):e as defined by documentation	Width (ft):	Thick	ness (ft):		Unknown
		Alternative m	ethod for determining size of iment	npacted zone (See source zo	ne definition attachmer	nts)		
_	Monitor V	Wells: Number of relevan	nt monitoring wells with ground			Deet to store to		None
		Number of wells re	elative to treatment zone:	Pre-treatment:		Post-treatment:		
		Pre-treatme	nt In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatme	ent In:	Upgradient:	Downgradient:	Cro	ssgradient:	
_	Soil Boring	gs: Number of relevant	t soil borings with pre-treatment	t data:				
		Number of relevant	t soil borings with post-treatmer	nt data:				
		Number inside trea	tment zone:	Number outside	treatment zone:			
х	Types of C	Contaminants						
_	<i></i>				Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
Γ		x Trichloroethene	Hexane	Creosote	None	None	None	None
		x Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		r,r-demorectione	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
								•
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		, , , , , , , , , , , , , , , , , , , ,	m/p-xylene		None	None	None	None
	Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		X Vinyl Chloride			None	None	None	None
		x DCE			None	None	None	None
					None	None	None	None
		x Total CHCs			100 mg/L	None	0.01 mg/L	None
					None	None	None	None
					None	None	None	None
L					None	None	None	None
	Comme	ents:						
	Attachmen	nts:						

Hyd	rogeologic Concep	tual Model		Facility ID#: 1070
<u>х</u>	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated segments are relatively homogeneous and impermeable unconsolidated and the Largely permeable sediments with inter-bedded lenses of the Largely impermeable sediments with inter-bedded layers of the Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated segments with inter-bedded lenses of the Largely permeable sediments with inter-bedded layers of the Largely impermeable sediments w	ediments sediments ower permeability material f higher permeability material ediments sediments sediments ower permeability material
	_ Ground surface e	elevation based on wells in o	adjacent to treatment zone: ft amsl	Unknown
<u>x</u>	Aquifer Character Is more than 1 ac Depth to water:		No x Yes (number): 4	inknown (assume single aquifer)
		high value (ft bgs): Unknown:	23 16.4	-
	_ Flow direction			-
	-	ulic gradient (feet/foot): gradient (feet/foot):		Unknown
	_ K range (ft/day)	Measured low high	using: Slug Test Laboratory	Field data Unknown
	Transmissivity (ft:	· ·	using: Slug Test Laboratory	Field data Unknown
		2nd aquifer permeability -	10^-5 m/s	Contamination in

Attachments:

The	rmal Treatment - Design								Facility ID#:	<u>1070</u>
<u>x</u>	Thermal treatment:		Conductive	·						
			Electrical F	Resistance						
		X	Steam	_3 phase		6 phase		_ AC powe	erDC	power
		Δ	x	Steam		Steam + air		_ Steam + 0	O2	
	Tune of Toots	Diles	Other (desc		anala Caratama					
X	Type of Test:	Pilot t		_	scale System		ahla un	consolidat	ted codiments	
X	Geology of Treatment Zone	: .		Relatively Largely pe Largely in Competer	homogened ermeable sen npermeable s	diments with in	neable iter-bed i inter-b e. cryst	unconsolio Ided lense edded lay	dated sediments es of lower permea ers of higher pern	•
<u>x</u>	Treatment Targe Zone:		Saturated	only	Vado	se only	<u>x</u>	Both (Sat	turated and Vadose	zones)
<u>x</u>	Start of Thermal Test:	Jan-0	1			Duration	n: <u>3 m</u> e	onths		
<u>x</u>	Hydraulic Control	<u>x</u>	Yes	No						
<u>x</u>	Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (ft Depth to top of target zone be Thickness of target zone be Number of energy delivery Number of extraction points Temperature Profile: Initial formation temperature	(ft bgs elow w points:	ater table ((ft):	1.5 6 16		-	Un		x ft)
	Maximum representative for	rmatio	n tempera	ture (deg C):				Unknown	
	Time to reach maximum re	presen	tative tem	perature (da	ays):				Unknown	
	Duration of treatment at rep	oresen	tative temp	perature (da	ays):				Unknown	
	Formation temperature imm Formation temperature pos Duration of post-treatment	t-treati	ment moni	toring even	t 1:	<u>Da</u>	ate_		Temperatui	re (deg C)
<u>x</u>	Mass of contaminant remove	ved:								
_			umping:					_ lb	kg	Unknow
	In va	apor sti	ream:					_ lb	kg	Unknow
	Tota	ıl:			10000	!	<u>x</u>	lb	kg	Unknow
	Comments:									
	10 water	and v	apor extra	action wells	s and 6 van	or extraction	wells o	nly		
	<u>10 Hator</u>	٧١							er injection wells	
	Attachments:									

Cost and Performance Facility ID#: 1070

Performance			
Remediation G	oal:		
	<u>x</u>	In Groundwater:	1) Facility area = total (CHCs) = 0.8 mg/L
			where domestic wells are located. Total (CHCs) = 0.2 mg/L
		_ In Soil:	
Was the Remed	diation	Goal Achieved:	
		Comment: —	
		-	
		_ In Soil	
		Comment: —	
		_	
General comme	ents or	n the thermal applica	ation:
General comme	ents or	т пе теппа аррпса	30011.
Target ter	mnerat	ture of - 89-100C	
rargerter	прета	ture or - 89-100C	
Lessons Learne	ed		
_			
_ Energy			2
Total Energy U	sed:		kWhr kWhr/m³ kWhr/yd³
	_ Tota	I energy applied to to	reatment zone: kWhr/m ³ kWhr/yd ³
	_ Othe	er energy:	kWhr/m ³ kWhr/yd ³
		Please	note other energy:
_ Cost			
Total Project Co	ost:		
	_ Cons	sultant Cost:	
	_ Ther	mal Vendor Cost:	
	Ener	rgy Cost:	m³ yd³
		er Cost 1:	
		er Cost 2:	
	_	er Cost 3:	
Please no	ote oth	er cost:	Other Cost 1:
		_	Other Cost 2:
			Other Cost 3:

<u>x</u> File Analyzed By: J	T <u>x</u> PD				Date:	10/30/2006
Type of treatment:	Conductive	x Steam	ERH	Other:		
Type of Contaminant:	x Chlorinated So	lvents _	Petroleum Hydrod	carbons	Pestici	des
	Wood Treating	<u> </u>	Other:			
Treatment Status:	Active	$\underline{\mathbf{x}}$ Post				
Type of Test:	Pilot Test	Full Sca	le System			
Start of Test:		En	d of Test:		_ Duration: 6	6 months
Type of Site:	x Non-DOD	DoD				
K Facility Name: Bruel &	Kjaer A/S (Project No.	552)				
Address:						
City, State, Zip Code:	<u>Denmark</u>					
OU# or Site #:						
Primary point of contact:						
Organization: <u>Danish</u>	Epa, Soil Contamination l	Division				
Address:						
City, State, Zip Code:						
Phone #: <u>+45 3266 01</u>	00	email: _				
Other contacts or vendors	who worked on site		None			
Point of contact:						
Type:Vendor,	, Consultant	Vendor, Techi	nical Applications	Oth	ier	
Organization:						
Address:						
City, State, Zip Code:						
Phone #:		email: _				
QA/QC						
Characteristics of Intere	est					
Good pre- and post-	treatment groundwater da	ıta	Good pre- a	and post-treatme	nt soil data	
Good temperature p			Flux assess	_		
Groundwater elevati			Geologic cr	oss-section		
Hydraulic Conducti	vity information					

<u>1075</u>

Gene	eral Site As	ssessment Data					Facility II	D#: <u>1075</u>
	Impacted	- "	direction)(ft.):s defined by documentation	Width (ft):	Thick	ness (ft):		Unknown
				npacted zone (See source zo	ne definition attachmen	its)		
		Map attachment	or for determining size of in	ipacica zone (oce source zo	ne deminion attacime	113)		
		wap attaciment						
	Monitor V	Wells: Number of relevant me	onitoring wells with groundy	water data:				None
	. WOITHOI V	rens. Humber of relevant in	ormoring wens with grounds	Pre-treatment:		Post-treatment:		None
		Number of wells relative	ve to treatment zone:	i io tiodunoni.		Tost treatment.		
		Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
		Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
					g			
	Soil Boring	gs: Number of relevant soil	I borings with pre-treatment	data:				
			I borings with post-treatmen					
		Number inside treatme	- '		treatment zone:			
		rambol moldo troduno		_ Number ducido				
<u>x</u>	Types of C	Contaminants						
_	71							
					Average Pre-treatme Chen	ent Concentration per		ent Concentration per nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		x Trichloroethene	Hexane	Creosote	None	None	None	None (mg mg)
		x Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1.2-dichloroethane	m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	o-xylene		None	None	None	None
	emicals of Concern	1,1,2-trichloroethane			None	None	None	None
	oncem	1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
		x Sum TCE and PCE			None	50 mg/kg	None	0.5 mg/kg
			<u> </u>		None	None	None	None
			<u> </u>		None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					110110	110110	110110	Tione
	Comme	ents:						
	Attachmer	nts:						

Hydrogeologic Conceptual Model Facility ID#: 1075 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone _ Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material X Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _ Unknown _ Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: _ Flow direction _ Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: ___ Slug Test Field data Laboratory ____ Unknown low

____ Slug Test

____ Laboratory

_ Field data

____ Unknown

high

low

high

Measured using:

Transmissivity (ft2/day):

Comments:

Attachments:

The	rmal Treatment - Design									Facility ID#:	<u>1075</u>
<u>x</u>	Thermal treatment:	Co	nductive								
		Ele	ctrical R	esistance							
				3 phase		6 phase	e		AC power	DO	C power
		<u>x</u> Ste		Steam		Steam	+ air		Steam + C	12	
		Oth	ner (descr			Steam	an	_	Steam 1 C	, <u> </u>	
	Type of Test:	On		Full-	scale S	lystem					
x	Geology of Treatment Zone	_				-	l permeal	ble unco	onsolidate	ed sediments	
-				•		•				ated sediments	
				-		-	-			of lower perme	
			_								meability material
						fractured bed					•
						ock, limesto		-	,		
<u>x</u>	Treatment Targe Zone:	Sa			<u>x</u>	Vadose only			Both (Satu	rated and Vadose	e zones)
<u>x</u>	Start of Thermal Test:				_	`	Duration:				
	_ Hydraulic Control	Ye:	s	No							
	-										
<u>x</u>	Treatment Cell Design:										
	Size of target zone (ft2):								Unk	nown (_ x ft)
	Thickness of target zone (ft	t):							Unk	nown	
	Depth to top of target zone	(ft bgs):			<u>50</u>				Unk	nown	
	Thickness of target zone be	elow wate	r table (f	t):					Unk	nown	
	Number of energy delivery	points:							Unk	nown	
	Number of extraction points	s:							Unk	nown	
	_Temperature Profile:										
	Initial formation temperature	e (deg C):								Unknow	n
	Maximum representative for	rmation te	emperati	ure (deg C):					Unknow	n
	Time to reach maximum re	presentati	ve temp	erature (da	ays):					Unknow	n
	Duration of treatment at rep	oresentativ	e tempe	erature (da	ays):					Unknow	n
							Date	<u>e</u>		Temperatu	ure (deg C)
	Formation temperature imn	nediately p	oost-trea	atment:							
	Formation temperature pos	st-treatmer	nt monito	oring even	t 1:						
	Duration of post-treatment	monitorino	g (days):								
<u>x</u>	Mass of contaminant remov	ved:									
	Via I	iquid pum	ping:						lb	kg	Unknown
	In va	apor strea	m:						lb	kg	Unknown
	Tota	ıl:			30	00 to 4000		<u>x</u>	lb	kg	Unknown
	Comments:										
	Table 4.4	12 000	(15005	5 v43/							
	Attachments:	ı∠,∪∪Um3	(15695	<u>yas)</u>							
	Attachments:										

Cost and Performance					Facility ID#:	<u>1075</u>
Performance						
Remediation Goal:						
_	In Groundwater: —					
_	_					
	In Soil:					
Was the Remediation	on Goal Achieved:					
_	In Groundwater					
	Comment: -					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³		
To	tal energy applied to t	reatment zone:			_ kWhr/m ³	kWhr/yd ³
Ot	her energy:	_			_ kWhr/m ³	kWhr/yd ³
	Please	note other energy:				
0						
Cost						
Total Project Cost:						
	onsultant Cost:					
	ermal Vendor Cost:			•	0	
	nergy Cost:			_ m ³	_ yd³	
	her Cost 1:					
Ot	her Cost 2:					
Ot	her Cost 3:					
Please note o	ther cost:	Other Cost 1:				
		Other Cost 2:				

____ Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	10/26/2006
	Type of treatment:	Conductive	<u>x</u>	Steam	ERH	Other:		
	Type of Contaminant:	X Chlorinated Sol	vents		Petroleum Hydro	carbons	Pesticio	des
		Wood Treating			Other:			
	Treatment Status:	Active		Post				
	Type of Test:	Pilot Test		Full Scale	System			
	Start of Test:			End	of Test: <u>2003</u>		Duration: 3	3.5 months
	Type of Site:	<u>x</u> Non-DOD		_DoD				
<u>x</u>	Facility Name: Odense, D	<u> Denmark</u>						
	Address:							
	City, State, Zip Code:	<u>Denmark</u>						
	OU# or Site #:							
<u>x</u>	Primary point of contact:	Danish EPA website						
	Organization:							
	Address:							
	City, State, Zip Code:							
	Phone #:			email:				
	Other contacts or vendors w	ho worked on site			None			
	Point of contact:							
	Type:Vendor, C				cal Applications	Oth		
	Organization:							
	Address:							
	City, State, Zip Code:							
	Phone #:		-	email:				
Q	A/QC							
_								
	_ Characteristics of Interest	;						
	Good pre- and post-tre	eatment groundwater dat	a		Good pre-	and post-treatme	nt soil data	
	Good temperature prof	file vs. time information			Flux assess	ment		
	Groundwater elevation	ns			Geologic c	oss-section		
	Hydraulic Conductivit	y information						

1080

General Site A	ssessment Data					Facility II	D#: <u>1080</u>
Impacte	Impacted zone a	v direction)(ft.):			ness (ft):	_	Unknown
	Map attachment		ipacied zone (See Source 20	ne delimilion attachmer	is)		
Monitor	Wells: Number of relevant m	nonitoring wells with ground	water data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	ive to treatment zone:					
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
Soil Bori	=	il borings with pre-treatment					
		il borings with post-treatmer					
	Number inside treatme	ent zone:	_ Number outside	treatment zone:			
x Types of	Contaminants					T	_
				Average Pre-treatme	nt Concentration per nical:		ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	x Trichloroethene	Hexane	Creosote	10 mg/L	10 mg/kg	0.1 mg/L	1 mg/kg
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comm	ents:						
Attachm	ents:						

Hydrogeologic Conceptua	Il Model		Facility ID#: 1080
Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lot Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lot Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	ediments sediments ower permeability material f higher permeability material ediments sediments sediments ower permeability material
,		adjacent to treatment zone: ft amsl	Unknown
Aquifer Characterist			
Is more than 1 aquif	er present?	_	Inknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3	- - -
Flow direction			_
Horizontal hydraulic Vertical hydraulic gr			Unknown
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
Transmissivity (ft2/d	low high ay): Measured low high		Unknown Field data Unknown
Comments:			
Attachments:			

Ther	rmal Treatment - Design									Facility ID#:	<u>1080</u>
<u>x</u>	Thermal treatment:		_ Condu	ctive _							
			_ Electri	cal Resistance	·						
		<u>x</u>	Steam	3 phase		6 phas	e		AC power	DC	power
		^		Steam		Steam	+ air		Steam + O2	2	
	Type of Teet	D'1.	_	(describe)	.111 . 0						
	_Type of Test: Geology of Treatment Zone	_ Pilot		Fi	ull-scale S	-	d normool	blo upor	ncolidato	d codiments	
	_Geology of Treatment Zone	3.	•		-	_	-				
			•		-	-	-			ted sediments of lower permea	ability material
			•		-					•	neability material
			•			fractured be				o or riighor pori	noability material
			•			ock, limesto		-	,		
	_Treatment Targe Zone:		Satura	ated only		Vadose only			Both (Satur	ated and Vadose	zones)
	Start of Thermal Test:					-	Duration:				
	_ Hydraulic Control		Yes	N	o						
	Treatment Cell Design:										
	Size of target zone (ft2):							,	Unkr	nown (_ x ft)
	Thickness of target zone (f	t):						•	Unkr	nown	
	Depth to top of target zone	(ft bg	ıs):						Unkr	nown	
	Thickness of target zone be	elow v	water ta	ble (ft):				•	Unkr	nown	
	Number of energy delivery		s:		<u>140</u>				Unkr		
	Number of extraction points	3:							Unkr	nown	
	_Temperature Profile:										
	Initial formation temperatur	e (de	a C).							Unknown	1
	Maximum representative for		- '	perature (dec	ı C):					Unknown	
	Time to reach maximum re		-							Unknown	
	Duration of treatment at rep			•						Unknown	l
							Date	<u>e</u>		Temperatu	re (deg C)
	Formation temperature imm	nedia	tely pos	t-treatment:							
	Formation temperature pos	t-trea	itment n	nonitoring ev	ent 1:	-				-	
	Duration of post-treatment	monit	oring (d	lays):					_		
<u>x</u>	Mass of contaminant remove										
			pumpin	g: _					lb 	kg	Unknown
			tream:	-	-	2000		· · · · · · · · · · · · · · · · · · ·	lb	kg	Unknown
	Tota	II.				3000		<u>C</u>	lb	kg	Unknown
	Comments:										
	Attachments:										

at and Performance				Facility ID#:	<u>1080</u>
_ Performance					
Remediation Goal:					
In Groun					
In Soil:					
· —					
Was the Remediation Goal Ach					
In Groun	dwater				
Co	mment:				
In Soil					
Co	mment:				
General comments on the therr	nal application:				
	пагаррисаноп.				
Lancona Laornad					
Lessons Learned					
-					
-					
_ Energy					
Total Energy Used:		1/W/he	kWhr/m ³	L/V	//br/vd ³
	nalised to transferent zone.	KWIII	KVVIII/III	KV _ kWhr/m³	viii/yd kWhr/
	pplied to treatment zone:				·
Other energy:				_ kWhr/m ³	kWhr
	_ Please note other energy:				
Cost					
Total Project Cost:					
Consultant Co	ct·				
Thermal Vend	JI COSt:		3	3	
Energy Cost:			m ³	_ yd³	
Other Cost 1:					
Other Cost 2:					
Other Cost 3:					
Please note other cost:	Other Cost 1:				
	Other Cost 2:				

Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD					Date:	10/26/2006
	Type of treatment:	Conductive	<u>x</u>	Steam	ERH	Other:		
	Type of Contaminant:	<u>x</u> Chlorinated Solv	vents	_	Petroleum Hydrocar	oons	Pesticio	des
		Wood Treating			Other:			
	Treatment Status:	Active	<u>x</u>	Post				
	Type of Test:	<u>x</u> Pilot Test		Full Scal	e System			
	Start of Test:	<u>2003</u>		End	of Test: 2003		Duration: 3	.5 months
	Type of Site:	<u>x</u> Non-DOD		_DoD				
<u>x</u>	Facility Name: <u>United Ki</u>	ngdom						
	Address:							
	City, State, Zip Code:	United Kingdom						
	OU# or Site #:							
X	Primary point of contact:	Helen Stevens						
	Organization: <u>IMS Mark</u>	xeting Communications						
	Address:							
	City, State, Zip Code:							
	Phone #: 0117 929 3041			email: hel	en.stevens@imsplc.com			
<u>x</u>	Other contacts or vendors w	ho worked on site			None			
	Point of contact: <u>Dur</u>	ncan Sanders						
	Type: Vendor, C	Consultant	_Ven	dor, Techn	ical Applications	Oth	ner	
	Organization: Churngold	d Remediation Ltd						
	Address:							
	City, State, Zip Code:							
	Phone #: <u>07881 815391</u>	or 0117 916 0510		email:				
Q	A/QC							
	_ Characteristics of Interest	i						
	Good pre- and post-tre	eatment groundwater data	a		Good pre- and	post-treatme	nt soil data	
	Good temperature pro	file vs. time information			Flux assessme	nt		
	Groundwater elevation	ns			Geologic cross	-section		
	Hydraulic Conductivit	ty information						

<u>1090</u>

General Site Assessment Data Facility										
Impacted	- · · ·		Width (ft):	Thick	ness (ft):		Unknown			
	 •	Impacted zone as defined by documentation								
		=	pacted zone (See source zo	ne definition attachmer	nts)					
	Map attachment									
Monitor	Wells: Number of relevant n	nonitoring wells with ground	vater data:				None			
			Pre-treatment:		Post-treatment:					
		tive to treatment zone:			_					
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:				
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:				
Soil Borin	ngs: Number of relevant so	oil borings with pre-treatment	data:							
	Number of relevant so	oil borings with post-treatmer	nt data:							
	Number inside treatme	ent zone:	_ Number outside	treatment zone:						
Types of	Contaminants									
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatm Chen	ent Concentration per nical:			
1	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)			
	Trichloroethene	Hexane	Creosote	None	None	None	None			
	Tetrachloroethene	Jet Fuel		None	None	None	None			
	1,1-dichloroethene	Napthalene		None	None	None	None			
	cis-1,2-dichloroethene	Benzene		None	None	None	None			
	trans-1,2-dichloroethene	Tolune		None	None	None	None			
	1,1-dichloroethane	Ethylbenzene		None	None	None	None			
	1,2-dichloroethane	m/p-xylene		None	None	None	None			
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None			
Concern	1,1,2-trichloroethane			None	None	None	None			
	1,1,2,2-tetrachloroethane			None	None	None	None			
	Vinyl Chloride			None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
				None	None	None	None			
Outputs -										
Comments:										
Attachme	ents:									

Hydrogeologic Conceptua	I Model		Facility ID#: 1090
Hydrogeologic Conceptua Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of lo Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock)	diments sediments over permeability material higher permeability material diments sediments over permeability material
Ground surface elev Aquifer Characteristi	ics:	Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl No Yes (number): U Aquifer 1 Aquifer 2 Aquifer 3	Unknown nknown (assume single aquifer)
Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:		-
Flow direction			-
Horizontal hydraulic Vertical hydraulic gra			Unknown
K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data
Transmissivity (ft2/da	high	using:Slug TestLaboratory	Field data Unknown
Comments:			
Attachments:			

Thermal Treatment - De	sign		Facilit	y ID#: <u>1090</u>
x Thermal treatment	Conductive			
	Electrical Resistance			
	3 phase X Steam	6 phase	AC power	DC power
	Steam Other (describe)	Steam + air	Steam + O2	
 X Type of Test: Geology of Treatm Treatment Targe Z 	x Pilot testFul ent Zone:Relativel Largely p Largely i Compete Weather	I-scale System y homogeneous and perme y homogeneous and imperr permeable sediments with ir mpermeable sediments with ent, but fractured bedrock (i. ed bedrock, limestone, sand	meable unconsolidated sec nter-bedded lenses of lowe n inter-bedded layers of hig e. crystalline rock) dstone	diments or permeability material other permeability material
Start of Thermal Te	 ,	-):	
Hydraulic Control	Yes No			
Number of energy Number of extraction Temperature Profil Initial formation ten Maximum represer Time to reach max	(ft2): zone (ft): get zone (ft bgs): zone below water table (ft): delivery points: on points:	days):		(x ft) Unknown Unknown Unknown Unknown
		<u>Da</u>	ate <u>Te</u>	mperature (deg C)
Formation tempera	ture immediately post-treatment:			
Formation tempera	ture post-treatment monitoring even	nt 1:		
Duration of post-tre	eatment monitoring (days):			
Mass of contamina				
	Via liquid pumping:		lbl	
	In vapor stream: Total:		lb l	
	i otai:		lb l	cg Unknown
Comments:				
Attachments:				

Cost and Performance				Facility ID#:	<u>1090</u>
Performance					
Remediation Goal:					
In Groundw	rater:				-
In Soil:					
Was the Remediation Goal Achiev	red:				
In Groundw					
Comn	nent:				
In Soil	•				
Comn	nent:				
General comments on the thermal	application:				
					
Lessons Learned					
Energy					
Total Energy Used:		kWhr	kWhr/m ³	kW	'hr/vd ³
Total energy app	lied to treatment zone:			kWhr/m³	kWhr/yd ³
Other energy:				_ kWhr/m³	kWhr/yd ³
	Please note other energy:				
x Cost					
Total Project Cost:	292950 (155000 GBP)				
Consultant Cost:					
Thermal Vendor	Cost:				
Energy Cost:			m ³	_ yd³	
Other Cost 1:					
Other Cost 2:					
Other Cost 3:	-				
Please note other cost:	Other Cost 1:				
	Other Cost 2:				

Other Cost 3:

<u>x</u>	File Analyzed By: JT	<u>x</u> PD			Date:			
	Type of treatment:	Conductive	ERH Other	:				
	Type of Contaminant:	Chlorinated So	lvents	Petroleum Hydrocarbons	Pesticides			
		<u>x</u> Wood Treating	; <u> </u>	Other:				
	Treatment Status:	Active	<u>x</u> Post					
	Type of Test:	<u>x</u> Pilot Test	Full Scal	e System				
	Start of Test:	5/12/99	Duration: <u>5.5 months</u>					
	Type of Site:	<u>x</u> Non-DOD	DoD					
<u>x</u>	Facility Name: <u>Taiwan</u>							
	Address:							
	City, State, Zip Code:	<u>Taiwan</u>						
	OU# or Site #:							
<u>x</u>	Primary point of contact:	Ken K. C. Tse						
	Organization: <u>Institute o</u>	f Environmental Engine	eering, National T	aiwan University, Taipei				
	Address: 106 Taiwan							
	City, State, Zip Code:	Republic of China						
	Phone #: 886-2-23963505	<u>5</u>	email: kts	e@ms17.hinet.net				
<u>x</u>	Other contacts or vendors who worked on siteNone							
	Point of contact: Jerry W. H. Wang							
	Type: <u>x</u> Vendor, Consultant Vendor, Technical Applications Other							
	Organization: Wang Eng	gineering Inc						
	Address: 105 Sherry Dr.							
	City, State, Zip Code:	West Chicago, IL 60	<u>185</u>					
	Phone #: <u>630-953-9928</u>		email:					
Q	A/QC							
	_ Characteristics of Interest	•						
	_	eatment groundwater da	ıta	Good pre- and post-trea	tment soil data			
		file vs. time information		Flux assessment	ament son data			
	Groundwater elevation			Geologic cross-section				
	Hydraulic Conductivit			Geologie closs-section				
	Trydraune conductivit	.j illioilliation						

<u>1100</u>

G	eneral Site Ass	sessment Data					Facility II	D#: <u>1100</u>
_	Impacted 2	- "	v direction)(ft.):		Thick	ness (ft):		Unknown
				npacted zone (See source zo	one definition attachmen	ts)		
		Map attachment		, , , , , , , , , , , , , , , , , , , ,		,		
<u>x</u>	Monitor W	/ells: Number of relevant m	nonitoring wells with ground	water data:				None
				Pre-treatment:	<u>5</u>	Post-treatment:	<u>5</u>	
		Number of wells relat	ive to treatment zone:					
		Pre-treatment	In: <u>2</u>	Upgradient:	Downgradient:	2 Cros	ssgradient:	
		Post-treatment	In: <u>2</u>	Upgradient:	Downgradient:	<u>2</u> Cros	ssgradient:	
<u>x</u>	Soil Boring	s: Number of relevant so	il borings with pre-treatment	data: <u>2</u>				
		Number of relevant so	il borings with post-treatmer	nt data: 2				
		Number inside treatme	ent zone: 2	Number outside	e treatment zone:			
<u>X</u>	Types of C	ontaminants		T	T		T	
					Average Pre-treatme	nt Concentration per	Average Post-treatm	ent Concentration per
					Chen	nical:	Chen	nical:
Н		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel	x PCP	10 mg/L	10 mg/kg	5 mg/L	5 mg/kg
	-	1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	Benzene		None	None	None	None
		trans-1,2-dichloroethene	Tolune		None	None	None	None
		1,1-dichloroethane	Ethylbenzene		None	None	None	None
		1,2-dichloroethane	m/p-xylene		None	None	None	None
	Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
	Concern	1,1,2-trichloroethane			None	None	None	None
		1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
L					None	None	None	None
	Commer	nte:						
	Comme							
	Attachmen	ts:						
		-						

Hydr	ogeologic Conceptual I	Model		Facility ID#: 1100
<u>x</u>	Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments x Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated s x Largely permeable sediments with inter-bedded lenses of low Largely impermeable sediments with inter-bedded layers of h Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated s x Largely permeable sediments with inter-bedded lenses of low	liments ediments ver permeability material nigher permeability material liments ediments
<u> </u>	Ground surface eleval Aquifer Characteristics Is more than 1 aquifer Depth to water:	s:	Largely impermeable sediments with inter-bedded layers of the Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone adjacent to treatment zone: No Yes (number): Aquifer 1 Aquifer 2 Aquifer 3	unigher permeability material —— Unknown known (assume single aquifer)
<u>x</u>	Flow direction		<u></u>	
X	Horizontal hydraulic g Vertical hydraulic grad		0.001 to 0.00033	Unknown Unknown
X	K range (ft/day)	Measured low high	Laboratory	Field data Unknown
	Transmissivity (ft2/day			Field data Unknown

Comments:

Attachments:

The	rmal Treatment - Design								Facility ID#:	<u>1100</u>
<u>x</u>	Thermal treatment:		_ Conductiv	е						
			_ Electrical	Resistance						
		<u>x</u>	Steam	_ 3 phase	-	6 phase		_ AC power	rDC	power
		-	X Other (des	Steam	_	Steam + air		_ Steam + C	D2	
~	Type of Test: <u>x</u>	Pilot	t test	Full-	ccale Suc	tam				
<u>x</u>	Geology of Treatment Zone			<u> </u>	-	neous and perm	ieable un	ıconsolidat	ed sediments	
^	Coology of Troutmont Zonk	.			_	neous and impe				
			<u>x</u>	-	_	•			s of lower permea	ahility material
			^						ers of higher perr	•
						ctured bedrock (noability material
						k, limestone, sar			,	
<u>x</u>	Treatment Targe Zone:		Saturated	_		adose only	<u>x</u>	Both (Sati	urated and Vadose	zones)
<u>x</u>	Start of Thermal Test:		2/1999	,		-	on: <u>5.5 i</u>			,
<u>x</u>	Hydraulic Control	x	Yes	No						
	•	_								
<u>x</u>	Treatment Cell Design:									
	Size of target zone (ft2):				2401			Unl	known (4	<u>49</u> x <u>49</u> ft)
	Thickness of target zone (f	t):			<u>33</u>			Unl	known	
	Depth to top of target zone	(ft bo	gs):		<u>0</u>			Unl	known	
	Thickness of target zone be	elow	water table	(ft):	<u>30</u>			Unl	known	
	Number of energy delivery	point	s:		1			Unl	known	
	Number of extraction points	s:					_	Unl	known	
	_ Temperature Profile:									
	Initial formation temperatur	e (de	g C):						Unknown	
	Maximum representative for	ormati	ion tempera	ture (deg C	:):	<u>100</u>			Unknown	
	Time to reach maximum re	prese	entative tem	perature (d	ays):	<u>30</u>			Unknown	
	Duration of treatment at rep	orese	ntative tem	perature (da	ays):	<u>135</u>			Unknown	
						<u> </u>	<u>Date</u>		Temperatu	re (deg C)
	Formation temperature imr									
	Formation temperature pos				nt 1:					
	Duration of post-treatment	monit	toring (days	5):						
	_ Mass of contaminant remo	ved:								
		-	pumping:						kg	Unknow
			stream:						kg	Unknow
	Tota	ıl:						_ lb	kg	Unknow
	Comments:									
	Attachments:									

Cost and Performance	Facility ID#: 1100
Performance	
Remediation Goal:	
In Groundwater:	_1 Mg/L
In Soil:	<u>1 Mg/kg</u>
Was the Remediation Goal Achieved:	
In Groundwater Comment:	<u>q</u> <u>p p g</u> <u>S</u>
Comment:	
la Cail	
In Soil	pp q p been done if groundwater had been pumped at the upper aquifer during the period of steam
Comment:	injection.
General comments on the thermal app	lication:
Cost doesn't include technical co	nsulation or design cost.
Laggang Lagrand	
Lessons Learned	
When treating SVOCs like PCP	soil vapor extraction system is not enough to remove all the steam stripped contaminants.
Groundwater pumping is still crud	sial for the success of in-situ thermal treatment. Besides the locations of pumping wells, the
extraction depth is also important	<u>. </u>
Energy	
Total Energy Used:	kWhr kWhr/m³ kWhr/yd³
Total energy applied t	o treatment zone: kWhr/m³ kWhr/yd³
Other energy:	kWhr/m ³ kWhr/yd ³
Plea:	se note other energy:
<u>x</u> Cost	
Total Project Cost:	
Consultant Cost:	
<u>x</u> Thermal Vendor Cost:	
Energy Cost:	m³ yd³
Other Cost 1:	
Other Cost 2:	
Other Cost 3:	
Please note other cost:	Other Cost 1:
	Other Cost 2:
	Other Cost 3:

	File Analyzed By: JT	<u>x</u> PD				Date:	10/18/2006
	Type of treatment:	Conductive	Steam	<u>x</u> ERH	Other:		
	Type of Contaminant:	<u>x</u> Chlorinated Solve	nts	Petroleum Hydro	ocarbons	Pesticides	
		Wood Treating	_	Other:			
	Treatment Status:	Active	<u>x</u> Post				
	Type of Test:	Pilot Test	x Full Scal	e System			
	Start of Test:	<u>Nov-02</u>	Enc	l of Test:		Duration: 60 d	
	Type of Site:	<u>x</u> Non-DOD	DoD				
<u>x</u>	Facility Name: Residenti	al Site in Holland					
	Address:						_
	City, State, Zip Code:	Zwijndrecht, Netherland	<u>ls</u>				
	OU# or Site #:						
<u>X</u>	Primary point of contact:	Bill Heath					
	Organization: <u>CES</u>						
	Address: 419 Entiat St.,						
	City, State, Zip Code:	Kennewick, WA 99336					
	Phone #: 509-727-4276		email: <u>bil</u>	1@cesiweb.com			
<u>x</u>	Other contacts or vendors w	ho worked on site		None			
	Point of contact: <u>Ing</u>	. Marcel Kolle					
	Type: Vendor, C	Consultant	Vendor, Techn	ical Applications	Oth	ner	
	Organization: <u>TerraVist</u>	a, BV					
	Address:						
	City, State, Zip Code:	Hoofdoorp, Netherlands	<u>i</u>				

1200

<u>x</u> Impacted	- "	w direction)(ft.): <u>below</u> as defined by documentation	Width (ft):	Thick	ness (ft):	_	Unknown					
		od for determining size of im	pacted zone (See source z	one definition attachmen	ts)							
Monitor V	Monitor Wells: Number of relevant monitoring wells with groundwater data: None											
			Pre-treatment:		Post-treatment:							
		tive to treatment zone:										
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:						
	Post-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:						
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data:									
	Number of relevant so	oil borings with post-treatmen	t data:									
	Number inside treatme	ent zone:	_ Number outsid	e treatment zone:								
x Types of C	Contaminants	Т	T			ľ						
				Average Pre-treatme	nt Concentration per nical:		ent Concentration per nical:					
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)					
	x Trichloroethene	Hexane	Creosote	None	None	None	None					
	x Tetrachloroethene	Jet Fuel		None	None	None	None					
	1,1-dichloroethene	Napthalene		None	None	None	None					
	x cis-1,2-dichloroethene	Benzene		None	None	None	None					
	trans-1,2-dichloroethene	Tolune		None	None	None	None					
	1,1-dichloroethane	Ethylbenzene		None	None	None	None					
	1,2-dichloroethane	m/p-xylene		None	None	None	None					
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None					
Concern	1,1,2-trichloroethane			None	None	None	None					
	1,1,2,2-tetrachloroethane			None	None	None	None					
	<u>x</u> Vinyl Chloride			None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
				None	None	None	None					
Comme			2000 m3 in	npacted (2615 yd3)								
Attachmer	nts:											
		<u> </u>	·		·	·						

1200

General Site Assessment Data

Hydr	rogeologic Conceptual	Model		Facility ID#: 1200
	_Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of lor Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sed Relatively homogeneous and impermeable unconsolidated sed Largely permeable sediments with inter-bedded lenses of lor Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments wer permeability material higher permeability material diments sediments wer permeability material
	_Ground surface eleva	ttion based on wells in o	adjacent to treatment zone: ft amsl	Unknown
<u>x</u>	Aquifer Characteristic			
	Is more than 1 aquife	r present?		nknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3 5 —————————————————————————————————	
	_Flow direction			
	_ Horizontal hydraulic g			Unknown
	_K range (ft/day)	Measured	using: Slug Test Laboratory	Field data
	Transmissivity (ft2/da	low high y): Measured low high	using: Slug Test Laboratory	Unknown Field data Unknown
	Comments:			
	Attachments:			

rmal Treatment - Design								Facility ID#:	<u>1200</u>
Thermal treatment:		Conductive							
	<u>x</u>	Electrical Re	sistance						
		3	3 phase		_ 6 phase		AC power	DC	power
		Steam							
			Steam		_ Steam + air		Steam + C)2	
		Other (descri	be)						
Type of Test:	_ Pilot	test 2	K Full-s	scale Syster	n				
Geology of Treatment Zone	e:		Relatively	homogene	eous and permea	ıble un	consolidate	ed sediments	
			Relatively	homogene	eous and imperm	eable	unconsolid	ated sediments	
		I	argely pe	rmeable s	ediments with int	er-bed	ded lenses	of lower perme	ability material
		١	_argely im	permeable	e sediments with	inter-b	edded laye	ers of higher peri	meability materi
			Competen	t, but fract	ured bedrock (i.e	. crysta	alline rock)		
		\	Neathered	d bedrock,	limestone, sands	stone			
_Treatment Targe Zone:		Saturated o	nly	Vad	ose only		Both (Satu	rated and Vadose	zones)
Start of Thermal Test:	Nov-	02			Duration:	60 d			
_ Hydraulic Control		Yes	No						
Treatment Cell Design:									
Size of target zone (ft2):						-	Unk	nown (_ x ft
Thickness of target zone (f	t):			<u>23</u>			Unk	nown	
Depth to top of target zone	(ft bgs	s):		<u>0</u>			Unk	nown	
Thickness of target zone be	elow w	ater table (ft)):				Unk	nown	
Number of energy delivery	points	:		<u>16</u>			Unk	nown	
Number of extraction points	s:					-	Unk	nown	
_ Temperature Profile:									
Initial formation temperatur	nah) a	(C).						Unknowi	1
Maximum representative for			re (dea C)					Unknown	
Time to reach maximum re		•						Unknowi	
Duration of treatment at rep		•						Unknown	
Duration of fleatine it at rep	preseri	itative tempe	rature (ua	ys).				Ulkilowi	ı
					<u>Dat</u>	t <u>e</u>		Temperatu	re (deg C)
Formation temperature imr	nediate	ely post-treat	ment:						
Formation temperature pos				1:					
Duration of post-treatment			Ü						
•		3 () ,							
_ Mass of contaminant remo	ved:								
Via	liquid p	oumping:					_ lb	kg	Unkno
In va	apor st	ream:					_lb	kg	Unkno
Tota	al:					<u>x</u>	lb	kg	Unkno
Comments:									
10 ft cno	cina	Treated - 2	000m3						
19 ft space	cing:	Treated - 2.	000m3						

Cost and Performance Facility ID#: 1200 Performance Remediation Goal: In Groundwater: Meet Dutch "C" MCLs In Soil: Meet Dutch "C" MCLs Was the Remediation Goal Achieved: ____ In Groundwater Comment: -___ In Soil Comment: General comments on the thermal application: Lessons Learned Energy ____ kWhr/m³ ___ kWhr/yd³ Total Energy Used: ____ kWhr kWhr/m³ _ kWhr/yd³ __ Total energy applied to treatment zone: kWhr/m³ ___ Other energy: kWhr/yd³ _ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ____ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3:

Other Cost 1:
Other Cost 2:
Other Cost 3:

Please note other cost:

File Analyzed By: Date: 10/18/2006 PD ____ Type of treatment: Conductive ____ Steam ____Other: ___ Pesticides Type of Contaminant: Petroleum Hydrocarbons Chlorinated Solvents <u>X</u> _Wood Treating Other: **PAHs** <u>X</u> Treatment Status: ___ Active Post Type of Test: _ Pilot Test Full Scale System Start of Test: Dec-03 End of Test: May-04 Duration: 28 weeks Type of Site: Non-DOD __ DoD Facility Name: Former Tarmac Plant Address: City, State, Zip Code: Zoetermeer, Netherlands OU# or Site #: _ Primary point of contact: Bill Heath Organization: **CES** Address: 419 Entiat St., Suite A City, State, Zip Code: Kennewick, WA 99336 Phone #: 509-727-4276 email: bill@cesiweb.com Other contacts or vendors who worked on site _ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: __ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

1210

General Site Information

___ Hydraulic Conductivity information

General Site A	ssessment Data					Facility II	D#: <u>1210</u>
Impacted	Impacted zone a				ness (ft):	_	Unknown
Monitor	Wells: Number of relevant r	monitoring wells with ground					None
	Number of wells rela Pre-treatment Post-treatment		Pre-treatment: Upgradient: Upgradient:	Downgradient:		ssgradient:	
Soil Boring	=	oil borings with pre-treatment oil borings with post-treatment nent zone:	nt data:	treatment zone:			
				Average Pre-treatme	ent Concentration per nical:		ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel	x PAHs	None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	<u>x</u> Benzene		None	None	None	None
	trans-1,2-dichloroethene	x Tolune		None	None	None	None
	1,1-dichloroethane	x Ethylbenzene		None	None	None	None
	1,2-dichloroethane	x m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	x o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
Concent	1,1,2,2-tetrachloroethane			None	None	None	None
	x Vinyl Chloride			None	None	None	None
	x dichloroethene			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				110110	110110	110110	Tione
Commo	ents:						
Attachme	nts:						

Hyd	rogeologic Conceptual	Model		Facility ID#: 1210
	_ Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated sex Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of local Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated sex Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of local Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments ower permeability material f higher permeability material ediments sediments ower permeability material
			adjacent to treatment zone: ft amsl	Unknown
<u>x</u>	Aquifer Characteristic		W (I)	
	Is more than 1 aquife Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	No Yes (number): X U Aquifer 1 Aquifer 2 Aquifer 3 2 3.6	nknown (assume single aquifer) - -
	_ Flow direction			-
	_ Horizontal hydraulic ç Vertical hydraulic gra			Unknown
	_ K range (ft/day)	Measured low	using: Slug Test Laboratory	Field data Unknown
	Transmissivity (ft2/da	high ny): Measured low high	using:Slug TestLaboratory	Field data Unknown
	Comments:			
	Attachments:			

rmal Treatment - Design						Facility ID#:	<u>1210</u>
Thermal treatment:	Con	ductive					
	<u>x</u> Elec	trical Resistance					
		3 phase	6 phase		_ AC power	DC	power
	Stea	· · · · · · · · · · · · · · · · · · ·					
	0.1	Steam	Steam -	- air	_ Steam + O2		
Tune of Teets	Othe	er (describe)	anala Cristiana				
Type of Test: Geology of Treatment Zon	_	_	scale System homogeneous and	nermeable ur	nconsolidated	sediments	
Coology of Troutmont 2011			homogeneous and	· ·			
		-	ermeable sediments	•			ability material
			npermeable sedime			•	-
		Competer	nt, but fractured bed	rock (i.e. crys	talline rock)		
		Weathere	d bedrock, limeston	e, sandstone			
_Treatment Targe Zone:	Sati	urated only	Vadose only		_ Both (Satura	ated and Vadose	zones)
Start of Thermal Test:	<u>Dec-03</u>		С	ouration: 28 v	weeks _		
_ Hydraulic Control	Yes	No					
Treatment Cell Design:							
Size of target zone (ft2):			<u>10868</u>		Unkno	`	<u>07</u> x <u>53</u> f
Thickness of target zone (33		Unkno		
Depth to top of target zone		table (ft).	1		Unkno		
Thickness of target zone b		table (It):	<u>32</u>		Unkno		
Number of energy delivery Number of extraction point	•		<u>43</u>		Unkno		
realiser of extraction point					Olikil	JWII	
_ Temperature Profile:							
Initial formation temperatu	re (deg C):					Unknown	
Maximum representative f	ormation ter	mperature (deg C):			Unknown	
Time to reach maximum re	epresentativ	e temperature (da	ays):			Unknown	
Duration of treatment at re	presentative	e temperature (da	nys):			Unknown	
				D-1-		T	(d 0)
Formation temperature im	mediately p	ost-treatment:		<u>Date</u>		<u>Temperatur</u>	re (deg C)
Formation temperature po			t 1:				
Duration of post-treatment		· ·					
_ Mass of contaminant remo		ina			11.	l	Unkno
	liquid pump apor stream	-			_ lb	kg	Unkno
Tota	•	l			_ lb lb	kg	Unkno
100	aı.			<u>X</u>	10	kg	Olikilo
Comments:							
28 week	s of operat	ion with three pl	nases of heating				
Attachments:		<u>-</u>					

Performance Remediation Goal: In Groundwater: DCE = 10 ppb; VC = 2.5 ppb In Soil: Was the Remediation Goal Achieved: x In Groundwater Comment: <u>ves</u> __ In Soil Comment: General comments on the thermal application: \$38.87/ton Lessons Learned Energy _ kWhr/yd³ Total Energy Used: 1200000 ___ kWhr ____ kWhr/m³ \underline{x} Total energy applied to treatment zone: kWhr/m³ kWhr/yd3 <u>135</u> kWhr/m³ ___ Other energy: kWhr/yd³ Please note other energy: Cost Total Project Cost: ____ Consultant Cost: __ Thermal Vendor Cost: _yd³ ___ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1: _ Other Cost 2:

Other Cost 3:

Facility ID#:

1210

Cost and Performance

File Analyzed By: <u>x</u> PD ____ Date: 10/26/2006 ____Steam ____Other: Type of treatment: ___ Conductive <u>x</u> ERH Type of Contaminant: _____Pesticides _ Chlorinated Solvents Petroleum Hydrocarbons ____ Wood Treating Other: Treatment Status: ____ Active Post ___ Full Scale System Type of Test: ____ Pilot Test Start of Test: End of Test: _____ Duration: 60 d Type of Site: ____DoD Non-DOD Facility Name: Confidential (Exxon) Address: City, State, Zip Code: Regina, SK OU# or Site #: _ Primary point of contact: Dacre Bush Organization: McMillian-McGee Address: City, State, Zip Code: Phone #: 805-295-9071 email: dacre.bush@mcmillian-mcgee.com Other contacts or vendors who worked on site __ None Point of contact: _____ Vendor, Technical Applications Type: ____ Vendor, Consultant ____ Other Organization: ___ Address: City, State, Zip Code: Phone #: email: ___ QA/QC ____ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information ___ Flux assessment ____ Groundwater elevations ____ Geologic cross-section

Facility ID#:

1220

General Site Information

_____ Hydraulic Conductivity information

Impacted	- "	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown				
		· ·	npacted zone (See source zo	one definition attachmen	its)						
Map attachment											
Monitor V	Vells: Number of relevant n	nonitoring wells with ground	water data:				None				
		Pre-treatment: Post-treatment:									
	Number of wells relat	tive to treatment zone:									
	Pre-treatment	In:	Upgradient:	Downgradient:		ssgradient:					
Post-treatment In: Upgradient: Downgradient: Crossgradient:											
Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	t data:								
	Number of relevant so	oil borings with post-treatmer	nt data:								
	Number inside treatme	ent zone:	_ Number outside	e treatment zone:							
Types of C	Contaminants	T	1			T					
				Average Pre-treatme			ent Concentration per nical:				
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)				
	Trichloroethene	Hexane	Creosote	None	None	None	None				
	Tetrachloroethene	Jet Fuel		None	None	None	None				
	1,1-dichloroethene	Napthalene		None	None	None	None				
	cis-1,2-dichloroethene	Benzene		None	None	None	None				
	trans-1,2-dichloroethene	Tolune		None	None	None	None				
	1,1-dichloroethane	Ethylbenzene		None	None	None	None				
	1,2-dichloroethane	m/p-xylene		None	None	None	None				
	1,1,1-trichloroethane	o-xylene		None	None	None	None				
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None				
	1,1,2,2-tetrachloroethane			None	None	None	None				
	Vinyl Chloride			None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
				None	None	None	None				
Comme	nts:										
Attachmer	nts:										
, accounted			_								

1220

General Site Assessment Data

Hydrogeologic Concept	tual Model		Facility ID#:	1220
Geology:	Zone	Unconsolidated Sediments		
	Vadose Zone:	Relatively homogeneous and permeable unconsolidated	d sediments	
		Relatively homogeneous and impermeable unconsolida	ted sediments	
		Largely permeable sediments with inter-bedded lenses	of lower permeability material	
		Largely impermeable sediments with inter-bedded layer	s of higher permeability materia	al
		Competent, but fractured bedrock (i.e. crystalline rock)		
		Weathered bedrock, limestone, sandstone		
	Saturated Zone:	Relatively homogeneous and permeable unconsolidated	d sediments	
		Relatively homogeneous and impermeable unconsolida	ted sediments	
		Largely permeable sediments with inter-bedded lenses	of lower permeability material	
		Largely impermeable sediments with inter-bedded layer	s of higher permeability materia	al
		Competent, but fractured bedrock (i.e. crystalline rock)		
		Weathered bedrock, limestone, sandstone		
Ground surface e	levation based on wells in o	or adjacent to treatment zone: ft amsl	Unknown	
Aquifer Character	ristics:			
Is more than 1 aq	uifer present?	No Yes (number):	_ Unknown (assume single aquife	r)
		Aquifer 1 Aquifer 2 Aquifer 3	3	
Depth to water:	low value (ft bgs):			
	high value (ft bgs):			
	Unknown:			
Flow direction				
				
Horizontal hydrau	ılic gradient (feet/foot):		Unknown	
-	gradient (feet/foot):		Unknown	
	g (
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data	
	low		Unknown	
	high			
Transmissivity (ft2	Ğ	using: Slug Test Laboratory	Field data	
rranonnooning (na	low		Unknown	
	high		Chkhown	
	riigii		_	
Comments:				
Comments.				
Attachments				
Attachments:				_
•	·			

Thermal treatment: Conductive Security Security	The	ermal Treatment - Design						Facility ID#:	<u>1220</u>
Steam Steam Steam Steam + sir Steam + O2	<u>x</u>	Thermal treatment:		Conductive					
Steam Steam Steam Steam + air Steam + O2 Steam			<u>x</u>	Electrical Resista	nce _				
Steam Steam + air Steam + O2 Other (describe) Type of Test:				3 pha	ase	6 phase	AC power	er D	C power
Type of Test: Pilot test Fill scale System Geology of Treatment Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of lower permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Treatment Targe Zone: Saturated only Valose only Both (Saturated and Valose zones) Start of Thermal Test: Duration: Hydraulic Control Yes No Treatment Cell Design: Size of target zone (ft2): Unknown Thickness of target zone (ft): Unknown Depth to top of target zone (ft): Unknown Number of entraction points: Unknown Number of extraction points: Unknown Number of extraction points: Unknown Temperature Profile: Initial formation temperature (deg C): Unknown Maximum representative temperature (deg C): Unknown Duration of treatment at representative temperature (days): Unknown Duration of post-treatment amonitoring event 1: Duration of post-treatment monitoring event 1: Duration of post-treatment monitoring event 1: Duration of post-treatment monitoring event 1: Duration in temperature post-treatment monitoring event 1: Duration in the past treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Visi liquid pumping: Ib kg Unknown Total: Ib kg Unknown Comments:				Steam					
Type of Test: Pilot lest Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments					m	Steam + air	Steam +	O2	
Geology of Treatment Zone: Relatively homogeneous and permeable unconsolidated sediments Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded lenses of higher permeability material Competent, but fractured bedrock, (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones) Start of Thermal Test: Duration: Hydraulic Control Yes No Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (ft2): Uluknown Depth to top of target zone (ft bgs): Uluknown Number of energy delivery points: Number of energy delivery points: Uluknown Unknown Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (deg C): Unknown Unknown Unknown Duration of treatment at representative temperature (days): Unknown Unknown Linknown Linknown Maximum representative post-treatment: Formation temperature post-treatment tremperature (days): Unknown Unknown Linknown Linknown									
Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded layers of higher permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock, limestone, sandstone Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones) Start of Thermal Test: Duration: Hydraulic Control Yes No Treatment Cell Design: Size of target zone (ft2): Thickness of target zone (ft2): Thickness of target zone (ft2): Unknown Number of energy delivery points: Unknown Unknown Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (deg C): Junknown Duration of treatment at representative temperature (days): Unknown Duration of post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: In by kg Unknown Comments:	_					-			
Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) weathered bedrock, limestone, sandstone Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones) Start of Thermal Test: Duration: Hydraulic Control Yes No Treatment Cell Design: Size of target zone (ft2): Unknown Depth to top of target zone (ft bgs): Unknown Number of energy delivery points: Unknown Number of energy delivery points: Unknown Temperature Profile: Initial formation temperature (deg C): Unknown Maximum representative formation temperature (deg C): Unknown Duration of treatment at representative temperature (days): Unknown Duration of post-treatment monitoring event 1: Duration of post-treatment monitoring (days): In vapor stream: In		_ Geology of Treatment Zon	e:		•				
Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones) Start of Thermal Test: Duration: Hydraulic Control Yes No Treatment Cell Design: Size of larget zone (ft2): Unknown Depth to top of target zone (ft bgs): Unknown Thickness of target zone (ft bgs): Unknown Number of energy delivery points: Unknown Number of extraction points: Unknown Temperature Profile: Initial formation temperature (deg C): Unknown Maximum representative formation temperature (deg C): Unknown Duration of treatment at representative temperature (days): Unknown Duration of post-treatment monitoring event 1: Duration of post-treatment monitoring days): Ib kg Unknown Via liquid pumping: Ib kg Unknown Total: Ib kg Unknown Comments:					-				
Competent, but fractured bedrock, (i.e. crystalline rock)Weathered bedrock, limestone, sandstone Treatment Targe Zone:Saturated onlyVadose onlyBoth (Saturated and Vadose zones) Start of Thermal Test:Duration: Hydraulic ControlYesNo Treatment Cell Design: Size of target zone (ft2):				_				•	-
Weathered bedrock, limestone, sandstone Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones) Start of Thermal Test: Duration: Hydraulic Control Yes No Treatment Cell Design: Size of target zone (ft2): Unknown (x ft) Thickness of target zone (ft): Unknown Depth to top of target zone (ft bgs): Unknown Number of energy delivery points: Unknown Number of energy delivery points: Unknown Number of extraction points: Unknown Temperature Profile: Initial formation temperature (deg C): Unknown Time to reach maximum representative temperature (days): Unknown Duration of treatment at representative temperature (days): Unknown Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: Ib kg Unknown Total: Ib kg Unknown Comments:									meability material
Treatment Targe Zone: Saturated only Vadose only Both (Saturated and Vadose zones) Start of Thermal Test: Duration: Hydraulic Control Yes No Treatment Cell Design: Size of target zone (ft2): Unknown (x ft) Thickness of target zone (ft9): Unknown Depth to top of target zone (ft bgs): Unknown Thickness of target zone (ft bgs): Unknown Number of energy delivery points: Unknown Number of extraction points: Unknown Temperature Profile: Initial formation temperature (deg C): Unknown Time to reach maximum representative temperature (days): Unknown Duration of treatment at representative temperature (days): Unknown Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring didays): Mass of contaminant removed: Via liquid pumping: In vapor stream: Ib kg Unknown Total: Ib kg Unknown Comments:				<u> </u>	-		-	•)	
Start of Thermal Test:		Treatment Targe Zone:		<u> </u>				turated and Vados	e zonec)
Hydraulic Control Yes No Treatment Cell Design: Size of target zone (ft2):				. Saturated offing	_				
Treatment Cell Design: Size of target zone (ft2):		_		Vac	No	Duranc			
Size of target zone (ft2): Thickness of target zone (ft): Depth to top of target zone (ft bgs): Thickness of target zone below water table (ff): Number of energy delivery points: Number of extraction points: Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (days): Duration of treatment at representative temperature (days): Duration temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: In vanown		_ riyaraano comior		, 103	_110				
Size of target zone (ft2): Thickness of target zone (ft): Depth to top of target zone (ft bgs): Thickness of target zone below water table (ff): Number of energy delivery points: Number of extraction points: Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (days): Duration of treatment at representative temperature (days): Duration temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: In vanown		Treatment Cell Design:							
Thickness of target zone (ft): Depth to top of target zone (ft bgs): Thickness of target zone below water table (ft): Number of energy delivery points: Number of energy delivery points: Initial formation temperature (deg C): Maximum representative formation temperature (deg C): Time to reach maximum representative temperature (days): Duration of treatment at representative temperature (days): Duration of treatment at representative temperature (days): Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: In va		_					Un	known (x ft)
Depth to top of target zone (ft bgs):Unknown Thickness of target zone below water table (ft):Unknown Number of energy delivery points:Unknown Number of extraction points:Unknown Temperature Profile:Unknown Temperature Profile:Unknown Maximum representative formation temperature (deg C):Unknown Time to reach maximum representative temperature (days):Unknown Duration of treatment at representative temperature (days):Unknown DateTemperature (deq C) Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping:			ft):						
Thickness of target zone below water table (ft): Number of energy delivery points: Number of extraction points: ———————————————————————————————————				s):			<u> </u>		
Number of extraction points:		Thickness of target zone b	elow w	ater table (ft):			Un	known	
Temperature Profile: Initial formation temperature (deg C): Maximum representative formation temperature (deg C): Time to reach maximum representative temperature (days): Duration of treatment at representative temperature (days): Date Temperature (deg C) Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Ib kg Unknown Comments:		Number of energy delivery	points	;:			Un	known	
Initial formation temperature (deg C):Unknown Maximum representative formation temperature (deg C):Unknown Time to reach maximum representative temperature (days):Unknown Duration of treatment at representative temperature (days):Unknown Date		Number of extraction point	ts:		_		Un	known	
Initial formation temperature (deg C):Unknown Maximum representative formation temperature (deg C):Unknown Time to reach maximum representative temperature (days):Unknown Duration of treatment at representative temperature (days):Unknown Date									
Maximum representative formation temperature (deg C):		_ Temperature Profile:							
Time to reach maximum representative temperature (days): Duration of treatment at representative temperature (days): Date Temperature (deq C) Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Comments:		Initial formation temperatu	re (deg) C):				Unknow	'n
Duration of treatment at representative temperature (days): Date Temperature (deg C)		Maximum representative f	ormatic	on temperature (d	deg C):			Unknow	'n
Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Date Temperature (deg C) Meg C Unknown Lib kg Unknown Total: Lib kg Unknown Unknown Total: Comments:		Time to reach maximum re	epreser	ntative temperatu	ıre (days):		Unknow	'n
Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: lb kg Unknown		Duration of treatment at re	presen	tative temperatu	re (days)):		Unknow	'n
Formation temperature immediately post-treatment: Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: lb kg Unknown									
Formation temperature post-treatment monitoring event 1: Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Comments:						<u> </u>	<u>ate</u>	Temperate	ure (deg C)
Duration of post-treatment monitoring (days): Mass of contaminant removed: Via liquid pumping: In vapor stream: Total: Comments:		Formation temperature im	mediate	ely post-treatmer	nt:				
		Formation temperature po	st-treat	ment monitoring	event 1:				
Via liquid pumping: lb kg Unknown In vapor stream: lb kg Unknown Total: lb Comments:		Duration of post-treatment	monito	oring (days):					
Via liquid pumping: lb kg Unknown In vapor stream: lb kg Unknown Total: lb Comments:									
In vapor stream:lbkgUnknown Total:lbkgUnknown Comments:		_							
Total: lbkg Unknown Comments:		Via	liquid p	oumping:			lb	kg	Unknown
Comments:		In v	apor st	ream:	-		lb	kg	
		Tota	al:				lb	kg	Unknown
Attachments:		Comments:							
Attachments:									
Attaciments.		Attachments:							
		Attachments:							

Cos	st and Performance			Facility ID	#: <u>1220</u>
	_ Performance				
	Remediation Goal:				
	In Groundwater:				
	<u></u> 0.00.10.11				
	In Soil:				
					-
	Was the Remediation Goal Achieved:				
	In Groundwater				
	Comment:				
	In Soil				
	Comment:				
	General comments on the thermal appli	ination			
	General comments on the thermal appli	cation:			
	D 100 007 1/1 1/00				
	Removed 99.9% of the VOCs				
	Lessons Learned				
<u>X</u>	Energy			_	_
	Total Energy Used: 215		kWhr	kWhr/m ³ <u>x</u>	kWhr/yd ³
	Total energy applied to	treatment zone:		kWhr/m ³	kWhr/yd ³
	Other energy:	-		kWhr/m ³	kWhr/yd ³
	Pleas	se note other energy:			
	_ Cost				
	Total Project Cost:				
	Consultant Cost:				
	Thermal Vendor Cost:				
		-		m³ yd³	
	Energy Cost:			$\underline{\hspace{1cm}}$ m ³ $\underline{\hspace{1cm}}$ yd ³	
	Other Cost 1:	-			
	Other Cost 2:				
	Other Cost 3:				
	Please note other cost:	Other Cost 1:			
		Other Cost 2:			
		Other Cost 3:			

<u>X</u> PD ____ File Analyzed By: Date: 11/13/2006 Type of treatment: ___ Conductive ____ Steam X ERH ____Other: Type of Contaminant: _____Pesticides _ Chlorinated Solvents X Petroleum Hydrocarbons ___ Wood Treating Other: Treatment Status: \underline{X} Post ___ Active Type of Test: Pilot Test ___ Full Scale System Start of Test: 2/19/1999 End of Test: 6/16/1999 Duration: 108 d Type of Site: Non-DOD __ DoD Facility Name: CFB Calgary Address: City, State, Zip Code: OU# or Site #: Calgary, Alberta, Canada Primary point of contact: Randall Warren Organization: Address: City, State, Zip Code: Phone #: 403-691-2954 email: ___ Other contacts or vendors who worked on site _ None Point of contact: Gary Millard Type: __ Vendor, Consultant _____ Vendor, Technical Applications __Other Organization: Shell Canada Address: City, State, Zip Code: Phone #: 403-216-5558 email: gary.millard@shell.com QA/QC ___ Characteristics of Interest Good pre- and post-treatment groundwater data ___ Good pre- and post-treatment soil data ____ Good temperature profile vs. time information __ Flux assessment ____ Groundwater elevations _ Geologic cross-section

Facility ID#:

1230

General Site Information

___ Hydraulic Conductivity information

X Impacted		w direction)(ft.):	Width (ft):	Thick	eness (ft):		X Unknown
	Alternative meth	od for determining size of im	pacted zone (See source zo	ne definition attachmer	nts)		
X Monitor V	Wells: Number of relevant n	nonitoring wells with groundy	vater data: Pre-treatment:		Post-treatment:		None
	Number of wells relat	tive to treatment zone:	Fie-treatment.	4	rost-treatment.	<u>4</u>	
	Pre-treatment	In: 4	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	In: 4	Upgradient:	Downgradient:		ssgradient:	
		···· -		g			
X Soil Boring	gs: Number of relevant so	oil borings with pre-treatment	data: <u>26</u>				
	Number of relevant so	oil borings with post-treatmen	t data: <u>12</u>				
	Number inside treatm	ent zone: 26	Number outside	treatment zone:	<u>12</u>		
X Types of 0	Contaminants						
					ent Concentration per nical:		nent Concentration per mical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	X Benzene		0.1 mg/L	1 mg/kg	0.1 mg/L	5 mg/kg
	trans-1,2-dichloroethene	X Tolune		0.001 mg/L	0.05 mg/kg	0.001 mg/L	0.05 mg/kg
	1,1-dichloroethane	X Ethylbenzene		0.005 mg/L	1 mg/kg	0.005 mg/L	5 mg/kg
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane	X Xylenes		0.01 mg/L	1 mg/kg	0.005 mg/L	5 mg/kg
	1,1,2,2-tetrachloroethane	X TPH		None	10 mg/kg	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
0							
Comme	ents:						
					<u> </u>		
Attachmer	nts:						

1230

General Site Assessment Data

Hydrogeologic Conceptual Model Facility ID#: 1230

<u>X</u>	Geology:	Zone	Unconsolidated Sediments
		Vadose Zone:	Relatively homogeneous and permeable unconsolidated sediments
			X Relatively homogeneous and impermeable unconsolidated sediments
			Largely permeable sediments with inter-bedded lenses of lower permeability material
			Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated sediments
			X Relatively homogeneous and impermeable unconsolidated sediments
			Largely permeable sediments with inter-bedded lenses of lower permeability material
			Largely impermeable sediments with inter-bedded layers of higher permeability material
			Competent, but fractured bedrock (i.e. crystalline rock)
			Weathered bedrock, limestone, sandstone
	_ Ground surface ele	evation based on wells in o	r adjacent to treatment zone: ft amsl Unknown
	_ Aquifer Characteris	stics:	
	Is more than 1 aqu	ifer present?	No Yes (number): Unknown (assume single aquifer)
			Aquifer 1 Aquifer 2 Aquifer 3
	Depth to water:	low value (ft bgs):	
		high value (ft bgs):	
		Unknown:	
	_ Flow direction		
	_ Horizontal hydrauli	c gradient (feet/foot):	Unknown
	Vertical hydraulic g	gradient (feet/foot):	Unknown
	_ K range (ft/day)	Measured	using: Slug Test Laboratory Field data
		low	Unknown
		high	
	Transmissivity (ft2/	'day): Measured	using: Slug Test Laboratory Field data
		low	Unknown
		high	
	Comments:		
	_		
	-		
	Attachments:		
	-		
	_		

The	rmal Treatment - Design								Facility ID#:	1230
<u>X</u>	Thermal treatment:		_ Conductive	·						
		<u>X</u>	Electrical F	Resistance						
				3 phase		_ 6 phase	A	C power	DC	power
			Steam	-						
			-	Steam		_ Steam + air	S	team + O2		
V	Turns of Tools	D:1.4	Other (desc							
<u>X</u>	Type of Test: X Geology of Treatment Zone	Pilot	test		scale Syster	n ous and permeab	alo uncor	acalidatad	codimente	
<u>X</u>	Geology of Treatment Zone		<u> </u>		_	ous and imperme				
			_	•	ū	ediments with inte				ability material
						sediments with in			•	=
			-		-	ured bedrock (i.e.		-	0 1	•
				Weathere	d bedrock,	limestone, sands	tone			
	_Treatment Targe Zone:		Saturated	only	Vad	ose only	B	oth (Satura	ted and Vadose	zones)
<u>x</u>	Start of Thermal Test:	19-F	eb-99			Duration:	108 d			
	_ Hydraulic Control		Yes	No						
<u>X</u>	Treatment Cell Design:									
	Size of target zone (ft2):				<u>3390</u>		_	Unkno	own (x ft)
	Thickness of target zone (ft)):			9		-	Unkno	own	
	Depth to top of target zone	(ft bg	s):		<u>5</u>		-	Unkno	own	
	Thickness of target zone be			ft):			-	Unkno	own	
	Number of energy delivery		S :		<u>6</u>		-	Unkno		
	Number of extraction points	:			<u>5</u>		-	Unkno	own	
<u>X</u>	Temperature Profile:									
_	Initial formation temperature	e (dec	a C):			10			Unknown	
	Maximum representative for			ure (deg C):	60			Unknown	
	Time to reach maximum rep	orese	ntative temp	perature (da	ays):	<u>96</u>			Unknown	
	Duration of treatment at rep	reser	ntative temp	erature (da	ıys):	<u>12</u>			Unknown	
						Date	<u>e</u>		Temperatu	re (deg C)
	Formation temperature imm	ediat	ely post-tre	atment:				_		
	Formation temperature post	t-trea	tment moni	toring event	t 1:			_		
	Duration of post-treatment r	nonit	oring (days)	:				_		
<u>X</u>	Mass of contaminant remov	od:								
Δ			pumping:	4	8.5 Liters +	117 Liters	lb	1	kg	Unknown
			tream:	<u> </u>	34.4 Li		1		kg	Unknown
	Total		ircam.		199.9 L		it		kg	Unknown
	Total									
	Comments:									
	20 ft elect	rode	spacing.	Actually	7 extracti	on points, but or	nly 5 cou	uld be ho	oked up at an	y one time.
	Attachments:									

Cos	t and Performanc	е					Facility ID#:	<u>1230</u>
<u>X</u>	Performance							
	Remediation Go	oal:						
		Х	In Groundwater:					
				Benzene-4.2 m	g/L, toluene-240 m	ng/L, ethylbenzene	e-50 mg/L, xylene	es-80 mg/L.
		X	In Soil:					
		_		Benzene-1.5 mg/Kg, to	oluene-340 ma/ka.	. ethylbenzene-400) ma/Ka. xvlenes	s-130 ma/Ka.
	Was the Remed	liatior	Goal Achieved:					
			_ In Groundwater					
			Comment:					
				_				
			_ In Soil					
			Comment:					
								
	General comme	ents o	n the thermal appli	cation:				
	Q	_			======			
				d efficiency of McMillan- s when ERH will be an e				
			roorganisms.					
	Lessons Learne	ed						
~	Enorgy							
<u>X</u>	Energy		400.0	00	V 1377	kWhr/m ³	1.34	n / 13
	Total Energy Us		<u>163,0</u>		X kWhr	KVVnr/m		
			al energy applied to	treatment zone:	<u>178</u>		_ kWhr/m ³	X kWhr/yd ³
		_ Othe	er energy:	-			_ kWhr/m ³	kWhr/yd ³
			Pleas	e note other energy:	-			
	_ Cost							
	Total Project Co	oct:						
	•		aultant Cost:					
			sultant Cost:					
		_	rmal Vendor Cost:			3	3	
		_	rgy Cost:			m ³	_ yd³	
		Othe	er Cost 1:					
		Othe	er Cost 2:					
		Othe	er Cost 3:					
	Please no	te oth	er cost:	Other Cost 1:				
				Other Cost 2:				

____ Other Cost 3: ___

<u>X</u>	File Analyzed By: JT	<u>X</u> PD						Date:	11/13/2006
	Type of treatment:	Conductive		_Steam	<u>X</u>	ERH	Other:		
	Type of Contaminant:	Chlorinated Sol	vents	<u>X</u>	Petro	leum Hydro	carbons	Pesticides	
		Wood Treating			Othe	r:			
	Treatment Status:	Active	<u>X</u>	Post					
	Type of Test:	X Pilot Test		Full Scale	e Systen	1			
	Start of Test:			End	of Test:			_ Duration: 60 d	
	Type of Site:	Non-DOD		_DoD					
<u>X</u>	Facility Name: <u>Crowchild</u>								
	Address:								
	City, State, Zip Code:								_
	OU# or Site #:								
X	Primary point of contact:	Randall Warren							
	Organization: Shell Cana								
	City, State, Zip Code:								
	Phone #: 403-691-2954			email:					
<u>X</u>	Other contacts or vendors wh	no worked on site				None			
	Point of contact: Gary	Millard							
	Type:Vendor, Co	onsultant	_Ven	dor, Techni	cal App	lications	Oth	er	
	Organization: Shell Cana	ı <u>da</u>							
	Address:								
	City, State, Zip Code:								
	Phone #: <u>403-216-5558</u>			email: gar	y.millar	d@shell.com	<u>1</u>		
Q	A/QC								
	_ Characteristics of Interest								
_	Good pre- and post-trea	atment groundwater dat	a			Good pre- a	and post-treatme	nt soil data	
	Good temperature prof	-				Flux assess	•		
	Groundwater elevation					Geologic cr			
	Hydraulic Conductivity	y information				-			
	Hydraulic Conductivity	y information							

<u>1240</u>

General Site As	ssessment Data					Facility II	D#: <u>1240</u>
Impacted	5 ".		Width (ft):	Thick	ness (ft):		Unknown
		as defined by documentation					
		=	pacted zone (See source zo	ne definition attachmer	nts)		
	Map attachment						
Monitor \	Wells: Number of relevant m	nonitoring wells with groundy	vater data:				None
	Number of wells relat	ive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cros	ssgradient:	
	Post-treatment	In:	Upgradient:	Downgradient:		ssgradient:	
		· · · · · · · · · · · · · · · · · · ·		-			
Soil Borin	gs: Number of relevant so	il borings with pre-treatment	data:				
	Number of relevant so	il borings with post-treatmen	nt data:				
	Number inside treatme	ent zone:	Number outside	treatment zone:			
Types of	Contaminants	<u> </u>				T	
				Average Pre-treatme	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
Chemicals of	1,1,1-trichloroethane	o-xylene		None	None	None	None
Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comm							
Comme							
							
Attachme	nts:						
							-

Hydrogeologic Concept	tual Model		Facility ID#:	<u>1240</u>
Geology:	Zone	<u>Unconsolidated Sediments</u>		
	Vadose Zone:	Relatively homogeneous and permeable unconsolidated	sediments	
		Relatively homogeneous and impermeable unconsolidate	ed sediments	
		Largely permeable sediments with inter-bedded lenses of	f lower permeability material	
		Largely impermeable sediments with inter-bedded layers	of higher permeability materi	ial
		Competent, but fractured bedrock (i.e. crystalline rock)		
		Weathered bedrock, limestone, sandstone		
	Saturated Zone:	Relatively homogeneous and permeable unconsolidated	sediments	
		Relatively homogeneous and impermeable unconsolidate	ed sediments	
		Largely permeable sediments with inter-bedded lenses of	f lower permeability material	
		Largely impermeable sediments with inter-bedded layers	of higher permeability mater	ial
		Competent, but fractured bedrock (i.e. crystalline rock)		
		Weathered bedrock, limestone, sandstone		
Ground surface e	levation based on wells in o	or adjacent to treatment zone: ft amsl	Unknown	
Aquifer Character	ristics:			
Is more than 1 aq	uifer present?	No Yes (number):	Unknown (assume single aquif	er)
		Aquifer 1 Aquifer 2 Aquifer 3		
Depth to water:	low value (ft bgs):			
·	high value (ft bgs):		_	
	Unknown:		_	
			_	
Flow direction				
			_	
Horizontal hydrau	ılic gradient (feet/foot):		Unknown	
-	gradient (feet/foot):		Unknown	
vertical flydraulic	gradient (rectroot).		Chkhown	
K range (ft/day)	Measured	using: Slug Test Laboratory	Field data	
K range (ivday)	low	Laboratory	I icid data Unknown	
	high		Chkhown	
Transmissivity (ft2	Ğ	using: Slug Test Laboratory	—- Field data	
Transmissivity (112	•	using: Slug Test Laboratory	· 	
	low		Unknown	
	high		_	
Comments:				
:				
Attachments:				
•				

The	rmal Treatment - Design							Facility ID#:	<u>1240</u>
<u>X</u>	Thermal treatment:		Conductive	·					
		<u>X</u>	Electrical R	Resistance					
				3 phase		_ 6 phase	AC po	wer DC	power
			Steam						
				_ Steam		_ Steam + air	Steam	+ O2	
			Other (desc		-				
<u>X</u>	Type of Test: X	Pilot t			-scale System				
	_ Geology of Treatment Zone	9:						dated sediments	
				-	_	•		olidated sediments ses of lower perme	ability material
								ayers of higher peri	-
						ured bedrock (i.			modeling material
			-	-		limestone, sand	-		
	_ Treatment Targe Zone:		Saturated	=				Saturated and Vadose	zones)
	_ Start of Thermal Test:								
	_ Hydraulic Control		Yes	No					
	_ Treatment Cell Design:								
	Size of target zone (ft2):						1	Unknown (_ x ft)
	Thickness of target zone (f	t):						Unknown	
	Depth to top of target zone	(ft bgs	.):					Unknown	
	Thickness of target zone be	elow w	ater table ((ft):	-			Unknown	
	Number of energy delivery	points:	:					Unknown	
	Number of extraction points	S:						Unknown	
.,	T								
<u>X</u>	Temperature Profile:	a /alaa	C).					II.1	
	Initial formation temperatur Maximum representative for			ture (dea C	٠)٠	100		Unknowi	
	Time to reach maximum re		•			100		Unknowi	
	Duration of treatment at rep				-			Unknowi	
	Duration of treatment at rep	3103011	alive temp	crature (de	ay3).			Chknown	1
						Da	ate	Temperatu	re (dea C)
	Formation temperature imr	nediate	ely post-tre	atment:					
	Formation temperature pos	st-treati	ment monif	toring even	nt 1:				
	Duration of post-treatment	monito	ring (days)):					
	_ Mass of contaminant remo	ved:							
	Via	iquid p	oumping:				lb	kg	Unknow
	In va	apor sti	ream:	_			lb	kg	Unknow
	Tota	ıl:					lb	kg	Unknow
	Comments:								
	19 ft elec	trode	spacing						
	Attachments:								
	-	•							

Cos	st and Performance					Facility ID#	1240
	_ Performance						
	Remediation Goal:						
		In Groundwater: -					
		_					
		In Soil:					
	Was the Remediation	on Goal Achieved:					
	_	In Groundwater					
		Comment: -					
		_					
	_	In Soil					
		Comment: —					
		_					
	General comments	on the thermal applica	ation:				
	Lessons Learned						
	-						
.,	_						
<u>X</u>	Energy				/ 3		
	Total Energy Used:			kWhr			kWhr/yd ³
		tal energy applied to t	reatment zone:	<u>227</u>	<u>X</u>	kWhr/m ³	kWhr/yd ³
	Oth	ner energy:	_			kWhr/m ³	kWhr/yd ³
		Please	note other energy:				
	_ Cost						
	Total Project Cost:						
	•	nsultant Cost:					
		ermal Vendor Cost:					
		ergy Cost:			m³	_yd³	
		3,				_ yu	
		ner Cost 1:					
		ner Cost 2:					
		ner Cost 3:	Oth C				
	Please note of	tner cost:	Other Cost 1:				
		_	Other Cost 2:				

____ Other Cost 3:

x File Analyzed By: JT	<u>x</u> PD				Date:	10/18/2006
Type of treatment:	Conductive	Steam	<u>x</u> ERH	Other:		
Type of Contaminant:	Chlorinated Solven	ts <u>x</u>	Petroleum Hydrocar	oons	Pesticides	
	Wood Treating		Other:			
Treatment Status:	Active x	Post				
Type of Test:	Pilot Test	Full Scale	e System			
Start of Test:		End	of Test:		Duration:	
Type of Site:	<u>x</u> Non-DOD _	DoD				
Y Facility Name: Operating Opera	g Texaco Gas Station					
Address:						_
City, State, Zip Code:	Luxembourg					
OU# or Site #:						
Primary point of contact:	Bill Heath					
Organization: <u>CES</u>						
Address: 419 Entiat St.,	Suite A					
City, State, Zip Code:	Kennewick, WA 99336					
Phone #: <u>509-727-4276</u>		email: bill	@cesiweb.com			
Other contacts or vendors w	tho worked on site		None			
Point of contact:	no worked on site		rtone			
Type: Vendor, (Consultant V	lendor Techni	ical Applications	Othe	or.	
				oun		
Address:						
City, State, Zip Code:						
Thole #.						
QA/QC						
Characteristics of Interes	t					
Good pre- and post-tr	eatment groundwater data		Good pre- and	post-treatmen	nt soil data	
Good temperature pro			Flux assessme	_		
Groundwater elevatio			Geologic cross			
Hydraulic Conductivi						

<u>1250</u>

(General Site Ass	sessment Data					Facility ID	D#: <u>1250</u>
=	Impacted 2	Impacted zone a	is defined by documentation od for determining size of im	Width (ft):		ness (ft):		Unknown
-	Monitor W	/ells: Number of relevant m	nonitoring wells with ground	water data:				None
		Number of wells relat Pre-treatment Post-treatment	In:	Pre-treatment: Upgradient: Upgradient:	Downgradient:		ssgradient:ssgradient:	
	Soil Boring Types of C		il borings with pre-treatment il borings with post-treatmer ent zone:	nt data:	treatment zone:			
					Average Pre-treatme Chen	ent Concentration per nical:	Average Post-treatme	ent Concentration per nical:
		Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
		Trichloroethene	Hexane	Creosote	None	None	None	None
		Tetrachloroethene	Jet Fuel		None	None	None	None
		1,1-dichloroethene	Napthalene		None	None	None	None
		cis-1,2-dichloroethene	x Benzene		None	None	None	None
		trans-1,2-dichloroethene	x Tolune		None	None	None	None
			x Ethylbenzene		None	None	None	None
		1,2-dichloroethane	x m/p-xylene		None	None	None	None
		1,1,1-trichloroethane	x o-xylene		None	None	None	None
	Chemicals of Concern	1,1,2-trichloroethane	,		None	None	None	None
	Concern	1,1,2,2-tetrachloroethane			None	None	None	None
		Vinyl Chloride			None	None	None	None
		viiiyi ciiionde			None	None	None	None
				-	None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
					None	None	None	None
٢					None	None	None	None
	Comme	nts:						
	Attachmen	ts:						
		-						

Hyd	rogeologic Conceptual	Model		Facility ID#: 1250
	_ Geology:	Zone Vadose Zone: Saturated Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated and sediments with inter-bedded lenses of the Largely permeable sediments with inter-bedded lenses of the Largely impermeable sediments with inter-bedded layers. Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Relatively homogeneous and permeable unconsolidated and sediments with inter-bedded lenses of the Largely permeable sediments with inter-bedded lenses of the Largely impermeable sediments with inter-bedded layers. Competent, but fractured bedrock (i.e. crystalline rock)	sediments ed sediments f lower permeability material of higher permeability material sediments ed sediments f lower permeability material
<u> </u>	Ground surface elevariant Aquifer Characteristic Is more than 1 aquife	es:	Weathered bedrock, limestone, sandstone adjacent to treatment zone: ft amsl No Yes (number): x	Unknown Unknown (assume single aquifer)
	Depth to water:	low value (ft bgs): high value (ft bgs): Unknown:	Aquifer 1 Aquifer 2 Aquifer 3 36 —————————————————————————————————	_ _ _
	_ Flow direction _ Horizontal hydraulic gra-			Unknown Unknown
	_ K range (ft/day) Transmissivity (ft2/da	Measured low high		Field data Unknown Field data
	Comments:	low high		I lota data
	Attachments:			

The	rmal Treatment - Design								Facility ID#:	1250	
<u>x</u>	Thermal treatment:		_ Conductive	·							
		<u>x</u>	Electrical I	Resistance							
				_ 3 phase		6 phase		AC power	DC	power	
			_ Steam	Steam		Steam + air	:	Steam + O2	2		
			Other (desc	cribe)							
	Type of Test:	_ Pilo	t test	Full	-scale Syste	m					
<u>X</u>	Geology of Treatment Zor	ne:		_ Relatively	/ homogen	eous and permea	able unco	onsolidated	d sediments		
						eous and imperm					
						sediments with in			•	•	
									s of higher peri	meability material	
					petent, but fractured bedrock (i.e. crystalline rock)						
				_		, limestone, sand					
	_ Treatment Targe Zone:		_ Saturated	only	Vac	dose only				zones)	
<u>X</u>	Start of Thermal Test:					Duration	:				
_	_ Hydraulic Control	_	_ Yes	No							
	To a toward Oall Davison										
<u>X</u>	Treatment Cell Design:								,		
	Size of target zone (ft2):	(f.)			<u>1615</u>		-	Unkn	-	_ x ft)	
	Thickness of target zone (ft): Depth to top of target zone (ft bgs): Thickness of target zone below water table (ft): Number of energy delivery points:							Unkn			
				(6.)				Unkn			
				(π):				Unkn			
					<u>13</u>			Unknown Unknown			
	Number of extraction poin	ts:						Unkn	iown		
	Tananaratura Drafila.										
	_ Temperature Profile:	/ ما م	~ C).						11.1		
	Initial formation temperatu		- '		.				Unknown		
	Maximum representative t		•						Unknown		
	Time to reach maximum r					-			Unknown		
	Duration of treatment at re	eprese	ntative temp	perature (da	ays):				Unknow	1	
						-			- .	(1 0)	
	Etitititi		4 - h 4 4	-1		<u>Da</u>	<u>te</u>		Temperatu	re (deg C)	
	Formation temperature im										
	Formation temperature po			-	IT 1:	-		_	-		
	Duration of post-treatmen	t moni	toring (days):							
	Mass of contaminant remo	oved:									
	_		pumping:				1	h	ka	Unknow	
									kg	Unknow	
		•	stream:				1		kg	Unknow	
	Tot	aı:					<u>x</u> 1	lb	kg	Unknow	
	0										
	Comments:										
	40.5	oir -									
	19 ft spa	acing									
	Attachments:										

t and Performance					Facility ID#:	<u>1250</u>
_ Performance						
Remediation Goal:						
	In Groundwater: —					
	In Soil:					
_						
Was the Remediation						
	Comment: —					
	_					
_	In Soil					
	Comment: —					
	_					
General comments	on the thermal applica	ation:				
-						
Lessons Learned						
-						
-						
Energy						
Total Energy Used:			1-11/1-4	kWhr/m	3 kV	Mbr/ud ³
	· · · · · · · · · · · · · · · · · · ·		KWIII		kWhr/m³	-
	tal energy applied to t	reatment zone:				kWhr/yo
Oth	ner energy:				kWhr/m ³	kWhr/yo
	Please	note other energy:				
Cost						
Total Project Cost:						
•						
	nsultant Cost:					
	ermal Vendor Cost:			3	3	
	ergy Cost:			m³	yd³	
	ner Cost 1:					
Oth	ner Cost 2:					
Oth	ner Cost 3:					
Please note of	ther cost:	Other Cost 1:				
	<u> </u>	Other Cost 2:				

____ Other Cost 3:

	Ella Anaharad Barri IT					D-1 10/20/200
<u>X</u>	File Analyzed By: JT		C4	EDII	Other	Date: <u>10/30/200</u>
	Type of treatment: Type of Contaminant:	<u>x</u> Conductive<u>x</u> Chlorinated Solv	Steam	ERH Patroloum I	Other: Hydrocarbons	Pesticides
	Type of Contaminant.	Wood Treating		Other:	•	resucides
	Treatment Status:	Active	x Post	_Other.		_
	Type of Test:	x Pilot Test	Full Scale	System		
	Start of Test:	- Aug-06		of Test: Oct-0)6	Duration: 2 months
	Type of Site:	x Non-DOD	DoD			
<u>x</u>	Facility Name: <u>Skuldele</u>	<u>v</u>				
	Address: <u>Vesterga</u>	<u>de</u>				
	City, State, Zip Code:	Skuldelev				
	OU# or Site #: Denmark					
<u>x</u>	Primary point of contact:	Gorm Heron				
	Organization: <u>TerraThe</u>	<u>rm</u>				
	Address: 10 Stevens Rd					
	City, State, Zip Code:	Fitchburg, MA 01420				
	Phone #: <u>978-343-0300</u>		email: ghe	ron@terrathern	n.com	
<u>x</u>	Other contacts or vendors v	who worked on site		None	;	
	Point of contact: Nie	els Ploug				
	Type:Vendor,	Consultant <u>x</u>	Vendor, Techni	cal Applicatio	onsOti	her
	Organization: Kruger A	<u>/S</u>				
	City, State, Zip Code:					
	Phone #: _011-45-39572	.061	email: NIF	@kruger.dk		
Q.	A/QC					
<u>x</u>	Characteristics of Interes	ıt				
_		eatment groundwater data	ı	<u>x</u> Good	l pre- and post-treatme	ent soil data
		ofile vs. time information		_	assessment	
	 X Groundwater elevation 				ogic cross-section	
	 X Hydraulic Conductive 	ity information				

1260

						Facility II	D#: <u>1260</u>	
Impacted 2	Zone: Length (parallel to flow	w direction)(ft.):	Width (ft):	Thick	ness (ft):		Unknown	
_ '	- "	as defined by documentation						
	Alternative meth	nod for determining size of im	ipacted zone (See source z	one definition attachmer	nts)			
	Map attachment	t						
Monitor W	/ells: Number of relevant r	Number of relevant monitoring wells with groundwater data:						
			Pre-treatment:	: <u>6</u>	Post-treatment:	<u>1</u>		
	Number of wells rela	tive to treatment zone:						
	Pre-treatment	In: <u>1</u>	Upgradient: 2	Downgradient:	<u>1</u> Cros	ssgradient: 2		
	Post-treatment	In: <u>1</u>	Upgradient:	Downgradient:	Cros	ssgradient:		
Soil Borings	s: Number of relevant so	oil borings with pre-treatment	data: 4					
	Number of relevant so	oil borings with post-treatmer	nt data: 3					
	Number inside treatm	ent zone: 3	Number outsid	de treatment zone:	<u>0</u>			
Types of C	ontaminants							
					ent Concentration per nical:		ent Concentration per nical:	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	
	Trichloroethene	Hexane	Creosote	None	None	None	None	
	x Tetrachloroethene	Jet Fuel		1,000 mg/L	5,000 mg/kg	10 mg/L	100 mg/kg	
	1,1-dichloroethene	Napthalene		None	None	None	None	
	cis-1,2-dichloroethene	Benzene		None	None	None	None	
	trans-1,2-dichloroethene	Tolune		None	None	None	None	
	1,1-dichloroethane	Ethylbenzene		None	None	None	None	
	1,2-dichloroethane	m/p-xylene		None	None	None	None	
)h ! f	1,1,1-trichloroethane	o-xylene		None	None	None	None	
chemicals of Concern	1,1,2-trichloroethane			None	None	None	None	
					l			
	1,1,2,2-tetrachloroethane			None	None	None	None	
	1,1,2,2-tetrachloroethaneVinyl Chloride			None	None None	None None	None None	
·				None	None	None	None	
				None None	None None	None None	None None	
				None None None	None None None	None None None	None None None	
				None None None None	None None None	None None None None	None None None None	

Hydr	ogeologic Conceptua	I Model		Facility ID#: 1260
X	Geology:	Zone Vadose Zone:	Unconsolidated Sediments Relatively homogeneous and permeable unconsolidated segments and impermeable unconsolidated segments with inter-bedded lenses of legal to the sediments with inter-bedded layers of the sediments with the sediments	sediments ower permeability material
		Saturated Zone:	Relatively homogeneous and permeable unconsolidated see Relatively homogeneous and impermeable unconsolidated Largely permeable sediments with inter-bedded lenses of log Largely impermeable sediments with inter-bedded layers of Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone	sediments ower permeability material
	Ground surface elev	ration based on wells in or	adjacent to treatment zone: ft amsl	<u>x</u> Unknown
X	Aquifer Characterist Is more than 1 aquif Depth to water:	er present? low value (ft bgs):	No <u>x</u> Yes (number): U Aquifer 1	Jnknown (assume single aquifer)
<u></u>	Flow direction Horizontal hydraulic Vertical hydraulic graphs	-	0.01	Unknown x Unknown
	K range (ft/day)	Measured (low high	sing:Slug TestLaboratory	<u>x</u> Unknown Field data Unknown
	Transmissivity (ft2/d	•	sing:Slug TestLaboratory	Field data Unknown
	Comments:			

Attachments:

Ther	mal Treatment - Design						Facility ID#:	<u>1260</u>
<u>x</u>	Thermal treatment:	<u>x</u> Conductive	·					
		Electrical F	Resistance					
			_3 phase		6 phase	AC power	DC	power
		Steam						
			_ Steam		Steam + air	Steam + O	2	
	T (T)	Other (desc						
<u>x</u>	Type of Test: <u>x</u>	Pilot test	Full-s	•		h l 15 d - 4 -	al a sadina a sata	
<u>x</u>	Geology of Treatment Zone					ble unconsolidate		
			-	-	•	eable unconsolida		
			_			er-bedded lenses	·	•
		<u>x</u>				inter-bedded laye	rs of nigher perr	neability material
						. crystalline rock)		
	Total and Tours 7				imestone, sands		. 1 137 1	
<u>X</u>	Treatment Targe Zone:	x Saturated	only	Vado	-	Both (Satu	rated and vadose	zones)
<u>X</u>	Start of Thermal Test:	Oct-06	NI.		Duration:	2 months		
<u>x</u>	Hydraulic Control	<u>x</u> Yes	No					
<u>x</u>	Treatment Cell Design:							
	Size of target zone (ft2):			200		Unk	nown (_ x ft)
	Thickness of target zone (fi	t):		<u>15</u>		Unk	nown	
	Depth to top of target zone	(ft bgs):		7		Unk	nown	
	Thickness of target zone be	elow water table ((ft):	<u>15</u>		Unk	nown	
	Number of energy delivery	points:		<u>4</u>		Unk	nown	
	Number of extraction points	s:		<u>4</u>		Unk	nown	
<u>x</u>	Temperature Profile:	(
	Initial formation temperatur		(-l O)		<u>10</u>		Unknown	
	Maximum representative for	·			100		Unknown	
	Time to reach maximum re				<u>60</u>		Unknown	
	Duration of treatment at rep	oresentative temp	erature (day	ys):	1		Unknown	
					Date	<u>e</u>	Temperatu	re (deg C)
	Formation temperature imm	nediately post-tre	atment:		<u>60</u>		80-100	
	Formation temperature pos	st-treatment moni	toring event	1:				
	Duration of post-treatment	monitoring (days)):					
v	Mass of contaminant remove	und:						
<u>x</u>		iquid pumping:		<u>11</u>		lb	<u>x</u> kg	Unknown
		apor stream:		<u>11</u> <u>24</u>		lb	<u>∧</u> kg <u>X</u> kg	Unknown
	Tota	•		35		lb	<u>x</u> kg	Unknown
	Tota			<u>33</u>		10	<u>A</u> Ng	Chkhown
	Comments:							
	Attachments:							
	<u></u>							

t and Performance					Facility ID#:	<u>1260</u>
_ Performance						
Remediation Goal:	_					
	_ In Groundwater: -					
	<u>-</u>					
	_ In Soil:					
Was the Remediation						
	_ In Groundwater _					
	Comment: -					
	_					
	_ In Soil _					
	Comment: -					
	_					
General comments o	on the thermal applica	ation:				
Lessons Learned						
Energy						
Total Energy Used:			kWhr	kWhr/m ³	kV	Vhr/vd ³
	al energy applied to t	treatment zone:			kWhr/m ³	kWhr/y
	er energy:				_ kWhr/m³	kWhr/y
		note other energy:			_ KVVIII/III	KVVIII/y
	Please	note other energy:	-			
Cost						
Total Project Cost:						
-	sultant Cost:					
	rmal Vendor Cost:					
	rgy Cost:			_ m ³	_ yd ³	
<u></u>	er Cost 1:			-'''	_ yu	
						
· 	er Cost 2:					
	er Cost 3:	0.1. 0				
Please note oth	ner cost:	Other Cost 1:				
		Other Cost 2:				

_ Other Cost 3:

General Site Information Facility ID#: 1270 File Analyzed By: PD ____ Date: 10/30/2006 JT ____Other: Type of treatment: Conductive Steam ERH Type of Contaminant: _____Pesticides Chlorinated Solvents X Petroleum Hydrocarbons _Wood Treating Other: Treatment Status: Active Post Type of Test: Pilot Test __ Full Scale System Start of Test: End of Test: Dec-07 Duration: Type of Site: __ DoD Non-DOD Facility Name: Dyrup Address: City, State, Zip Code: Dyrup OU# or Site #: Denmark Primary point of contact: Gorm Heron Organization: TerraTherm Address: 10 Stevens Rd City, State, Zip Code: Fitchburg, MA 01420 Phone #: 978-343-0300 email: gheron@terratherm.com Other contacts or vendors who worked on site _ None Point of contact: Type: Vendor, Consultant <u>x</u> Vendor, Technical Applications ____Other Organization: Address: City, State, Zip Code: Phone #: email: __ QA/QC Characteristics of Interest Good pre- and post-treatment groundwater data Good pre- and post-treatment soil data <u>X</u> <u>X</u> Good temperature profile vs. time information Flux assessment <u>X</u> <u>X</u> Groundwater elevations Geologic cross-section <u>X</u>

Hydraulic Conductivity information

X

General Site As	sessment Data					Facility ID	D#: <u>1270</u>
Impacted	- "	w direction)(ft.):		Thick	ness (ft):	<u> </u>	Unknown
	 :	•		na definition attachmen	40)		
		nod for determining size of im	ipacted zone (See source zo	ine definition attachmen	its)		
	Map attachment	L					
Monitor V	Vells: Number of relevant n	monitoring wells with groundy			Don't transfer and		None
	Number of wells relat	tive to treatment zone:	Pre-treatment:		Post-treatment:		
	Pre-treatment	In:	Upgradient:	Downgradient:	Cro	ssgradient:	
	Post-treatment	<u></u>	Upgradient:	Downgradient:		ssgradient:	
	T oot abdanon	<u></u>	<u></u>	20migradioni:			
Soil Boring	ns: Number of relevant so	oil borings with pre-treatment	data:				
		oil borings with post-treatmen					
	Number inside treatme	- '		treatment zone:			
	rumbor morae aream.		Trainbor outoide	_			
Types of C	Contaminants						
				Average Pre-treatme	ent Concentration per	Average Post-treatme	
	Chlorinated Solvents	Petroleum Hydrocarbons	Other	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)
	Trichloroethene	Hexane	Creosote	None	None	None	None
	Tetrachloroethene	Jet Fuel		None	None	None	None
	1,1-dichloroethene	Napthalene		None	None	None	None
	cis-1,2-dichloroethene	Benzene		None	None	None	None
	trans-1,2-dichloroethene	Tolune		None	None	None	None
	1,1-dichloroethane	Ethylbenzene		None	None	None	None
	1,2-dichloroethane	m/p-xylene		None	None	None	None
	1,1,1-trichloroethane	o-xylene		None	None	None	None
Chemicals of Concern	1,1,2-trichloroethane			None	None	None	None
	1,1,2,2-tetrachloroethane			None	None	None	None
	Vinyl Chloride			None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
				None	None	None	None
Comme	nts:						
Attachmer	nts:						
	<u> </u>					·	

Hydrogeologic Conceptual Model Facility ID#: 1270 **Unconsolidated Sediments** Geology: Zone Vadose Zone: Relatively homogeneous and permeable unconsolidated sediments _ Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone _ Relatively homogeneous and permeable unconsolidated sediments Saturated Zone: Relatively homogeneous and impermeable unconsolidated sediments Largely permeable sediments with inter-bedded lenses of lower permeability material Largely impermeable sediments with inter-bedded layers of higher permeability material Competent, but fractured bedrock (i.e. crystalline rock) Weathered bedrock, limestone, sandstone Ground surface elevation based on wells in or adjacent to treatment zone: _____ ft amsl Unknown _ Aquifer Characteristics: Is more than 1 aquifer present? Yes (number): _ Unknown (assume single aquifer) Aquifer 3 Aquifer 1 Aquifer 2 Depth to water: low value (ft bgs): high value (ft bgs): Unknown: Flow direction _ Horizontal hydraulic gradient (feet/foot): __ Unknown Vertical hydraulic gradient (feet/foot): _ Unknown _ K range (ft/day) Measured using: __ Slug Test Field data Laboratory ____ Unknown low high

____ Slug Test

____ Laboratory

_ Field data

____ Unknown

Transmissivity (ft2/day):

Comments:

Attachments:

Measured using:

low

high

The	rmal Treatment - Design					Facility ID#:	<u>1270</u>
<u>x</u>	Thermal treatment:	<u>x</u> Conductive					
		Electrical Resistance	·				
		3 phase	_	_ 6 phase	AC power	DC	power
		Steam					
		Steam	_	Steam + air	Steam + C	2	
		Other (describe)					
<u>x</u>	Type of Test: <u>x</u>	Pilot test Fu	ull-scale Syste	m			
<u>x</u>	Geology of Treatment Zone	e: Relative	ely homogen	eous and permea	able unconsolidate	ed sediments	
		Relative	ely homogen	eous and imperm	eable unconsolid	ated sediments	
		Largely	permeable :	sediments with int	ter-bedded lenses	of lower perme	ability material
		<u>x</u> Largely	impermeabl	e sediments with	inter-bedded laye	rs of higher peri	neability material
		Compe	tent, but frac	tured bedrock (i.e	e. crystalline rock)		
		Weathe	ered bedrock	, limestone, sand	stone		
<u>X</u>	Treatment Targe Zone:	Saturated only	Va	dose only	Both (Satu	rated and Vadose	zones)
	_ Start of Thermal Test:			Duration:			
	_ Hydraulic Control	Yes N	O				
<u>x</u>	Treatment Cell Design:						
_	Size of target zone (ft2):		<u>500</u>		Unk	nown (_ x ft)
	Thickness of target zone (f	t):	<u>20</u>		Unk	nown	
	Depth to top of target zone		20		Unk	nown	
	Thickness of target zone be	elow water table (ft):	<u>0</u>		Unk	nown	
	Number of energy delivery	points:	<u>6</u>		Unk	nown	
	Number of extraction points	s:			Unk	nown	
<u>x</u>	Temperature Profile:						
Δ	Initial formation temperatur	re (dea C):				Unknowi	1
	Maximum representative for		ı C):	100		Unknowi	
	Time to reach maximum re			60		Unknowi	
	Duration of treatment at rep			<u>5</u>		Unknowi	
	·	•	, ,	_			
				<u>Da</u>	<u>te</u>	Temperatu	re (deg C)
	Formation temperature imr	nediately post-treatment:					
	Formation temperature pos	st-treatment monitoring ev	ent 1:				
	Duration of post-treatment	monitoring (days):					
<u>x</u>	Mass of contaminant remo	ved:					
	Via I	liquid pumping:			lb	kg	Unknown
	In va	apor stream:			lb	kg	Unknown
	Tota	al:			lb	kg	Unknown
	Comments:						
	Attachments:						

Cost and Performance Facility ID#: 1270 Performance Remediation Goal: _ In Groundwater: -__ In Soil: Was the Remediation Goal Achieved: ____ In Groundwater Comment: ___ In Soil Comment: General comments on the thermal application: Lessons Learned Energy __ kWhr/yd³ ____ kWhr/m³ Total Energy Used: ____ kWhr _kWhr/yd³ kWhr/m³ _ Total energy applied to treatment zone: _ kWhr/m³ _ kWhr/yd³ ___ Other energy: Please note other energy: Cost Total Project Cost: ____ Consultant Cost: ___ Thermal Vendor Cost: ____ Energy Cost: ____ Other Cost 1: ____ Other Cost 2: ____ Other Cost 3: Please note other cost: Other Cost 1: Other Cost 2:

Other Cost 3:

APPENDIX D

Site Specific Demonstration Plans and Data Analysis Reports:

- Camp LeJeune
- NAS Alameda Bldg. 5
- Air Force Plant 4
- Hunter Army Airfield
- Ft. Lewis East Gate Disposal Yard Area 3

ER-0314 Appendix D

Draft Final

Site Specific Demonstration Plan Camp LeJeune – Site 89

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:

Arizona State University Battelle Memorial Institute Site 89 at the Camp Geiger portion of Marine Corps Base (MCB) Camp LeJeune is located near the intersection of "G" and Eighth Streets as shown in Figure 1. Site 89 property consists of the fenced portion of the former Defense Reutilization Marketing Office (DRMO); however, the area of impact associated with Site 89 extends beyond the fence to Edwards Creek and includes the wooded area to the east and south of the DRMO as well as a portion of Camp Geiger to the west.

Until June 2000, Site 89 was used primarily as a storage yard for the DRMO. The primary function of the former DRMO was one of managing scrap and surplus metal. Rubber tires, fuel bladders (mobile fuel storage tanks), and other materials were also managed alt the site. Previous to DRMO operations, Site 89 was the site of the Base Motor Pool operations through approximately 1988, when it was relocated.

Through multiple investigations beginning in 1996, Site 89 was identified as the major source of chlorinated groundwater and surface water contamination. The later investigation identified free-phase dense non-aqueous phase liquids (DNAPL) present below the water table, with the DNAPL consisting mainly of 1,1,2,2-tetrachloroethane (PCA) and trichloroethene (TCE). The DNAPL source area was determined to be about 8,900 square feet in size.

The conceptual subsurface model for Site 89 includes three underlying geological formations and surface water bordering the area. The undifferentiated formation (surficial aquifer) occurs at a depth of approximately five feet below land surface (bls). The Belgrade formation (Castle Hayne confining unit) begins at a depth of approximately 8 to 15 feet bls, and the River Bend formation (Castle Hayne aquifer) begins at a depth of approximately 14 to 20 feet bls.

Electrical resistive heating (ERH) was selected as the technology to remove the free-phase DNAPL. Installation of the pilot test ERH system began in April 2006. The system consisted of 43 deep heating electrodes installed to a depth of 26 feet bls and 48 shallow heating electrodes installed to a depth of 19 feet bls. The total treatment area, shown in Figure 2, was roughly 15,900 square feet.

An additional 23 monitoring wells were installed both inside and immediately surrounding the pilot test area. These monitoring wells were classified as shallow type II monitoring wells and deep type III monitoring wells. Both type II and III monitoring wells were constructed with 2-inch diameter stainless steel screen, riser, and end cap. The type II wells screen section was 10-feet long extending from 5 to 15 feet bls with 0.010-inch wire wrap slots. The type III wells screen section was 5-feet long extending from 20 to 25 feet bls with 0.010-inch wire wrap screen. These monitoring wells along with four existing monitoring wells (MW-16, MW16IW, MW-17, and MW-17IW) were used to assess the effectiveness of the ERH technology as well as monitoring DNAPL and any possible dissolved phase contaminant migration.

The pilot system was brought on-line in September 2003 and was operated until the beginning of May 2004. The remedial system performance was continuously monitored during operation, and an estimated 48,000 pounds of volatile organic compound (VOC) contamination were removed in recovered volatile vapors and 428 pounds of chlorinated compounds were recovered from the groundwater during the pilot.

After the shutdown of the pilot system, the monitoring well network was monitored for 1 year. After a year the electrodes were covered by digging down 1 foot and cutting off the casing then covering with soil. All the monitoring wells were left in place.

The available documentation for Camp LeJeune suggests that it is a good site for further investigation because:

- The hydrogeology of the site is reasonably well-characterized
- The aerial extent of the source zone was reasonably defined prior to treatment
- Full treatment of a source zone was attempted
- The depth to groundwater is 5 feet
- The total depth to impacted groundwater is about 38 feet
- There is access to sampling locations immediately down-gradient of the remediated source zone
- The system employed at this site represents a state-of-the-art ERH system
- Pre- and post-treatment groundwater data are available
- Direct-push technologies can be used for sampling
- The monitoring well network is still present and accessible

Consistent with the already-approved generic demonstration plan for this project, the following site-specific activities are proposed:

- (1) Verification of the site geological conceptual model before any new investigative work by:
 - a. Measurement of depths to groundwater in nearby wells (to determine depth to groundwater, flow direction, and hydraulic gradient). See Table 1 for details on the monitoring wells and Figure 2 for measurement location.
 - b. Collection of one continuous soil core near the dissolved plume core at the down-gradient edge of the treated source zone (to qualitatively confirm the site geology and to identify depths for subsequent groundwater sampling). Additional cores will be collected if time permits. See Table 1 for details on the monitoring wells and Figure 2 for measurement location.
 - c. Slug tests conducted in existing groundwater monitoring wells in the area to get estimates of hydraulic conductivity over the screened intervals of those wells (to help identify if any zones are more conductive than others). See Table 1 for details on the monitoring wells and Figure 2 for measurement location.
- (2) Collection of data necessary to determine groundwater concentrations and fluxes leaving the treated source zone:
 - a. Groundwater samples collected from existing groundwater monitoring wells with available historical data See Table 1 for details on the monitoring wells and Figure 2 for measurement location.
 - b. Groundwater samples will be collected using direct-push tools along a transect perpendicular to the direction of groundwater flow and across the width of the original source zone. See Figure 2 for groundwater sampling locations. The boreholes will be approximately 50 feet apart and will be sampled at least every 4 feet down to a depth of 38 ft (and at least once in each distinct lithologic change

- suggested by the soil core). Groundwater will be collected in 40 mL volatile organic analysis (VOA) bottles with a peristaltic pump. The samples will be analyzed via a headspace analysis on a gas chromatograph (GC) equipped with electron capture (ECD) and flame-ionization (FID) detectors. If time permits, samples will be collected at other locations as well. The specific depths and numbers of samples collected at each location may be adjusted depending on the analysis results in the field.
- c. Aquifer specific-capacity tests will be conducted at each depth where a groundwater sample is collected. These tests are to be conducted using the direct-push groundwater sampler. Specific capacity tests involve the measurement of the steady flow rate achieved with a fixed drawdown; ideally, all tests will be conducted with the same fixed drawdown (usually 0.3 1.0 feet).

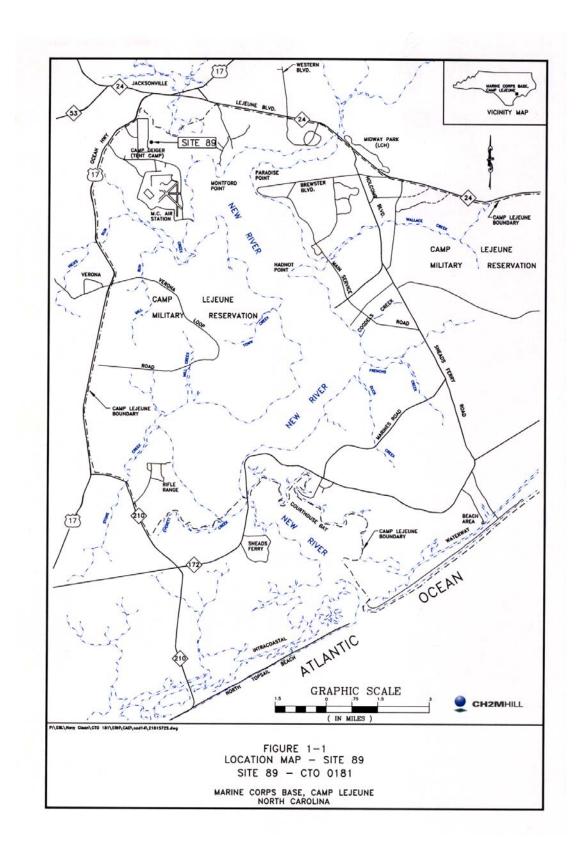


Figure 1: Site location map

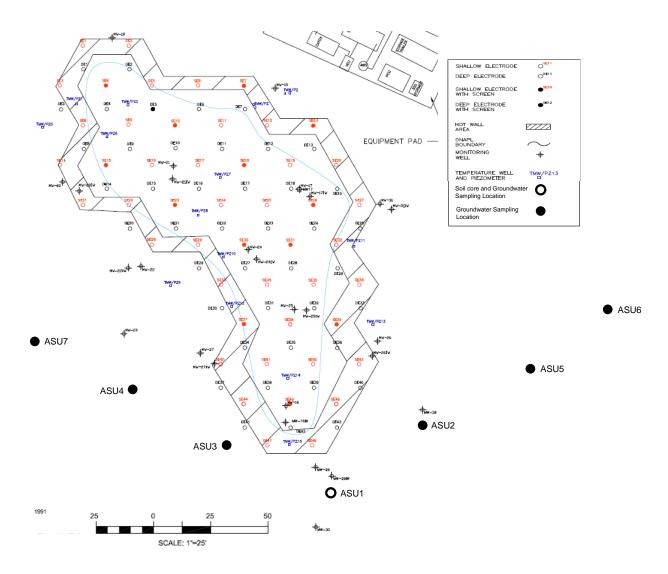


Figure 2. Direct-Push Locations

Health and Safety Plan (HASP) Camp LeJeune – Site 89

SECTION 1: GENERAL INFORMATION AND DISCLAIMER	
CLIENT NAME: Environmental Security Technology Certification P	Program (ESTCP) PROJECT NAME: ESTCP Thermal Evaluation
PRINCIPAL INVESTIGATORS: Bruce Alleman (Battelle) and Paul	Johnson (Arizona State University)
PROJECT LEADER: Sam Yoon	
PREPARED BY: Sam Yoon	DATE: 09/15/2005
is written for the specific LEVEL D site co specified. If these conditions change, a new named in Section 17. Subcontractors shall be solely responsible for the health and laws and regulations. In accordance with 1910.120(b)(1)(in the emergency response procedures, and any potential fire, exp Specific Safety and Health Plan and site information obtain contractors and subcontractors are responsible for: (1) dever Hazard Communication Program and any other written haz and regulations; (2) providing their own personal protective employees have been health and safety trained in accordance providing evidence of medical surveillance and medical approviding contractors are responsible for ensuring that their employees have been health and safety trained in accordance providing evidence of medical surveillance and medical approviding contractors are responsible for ensuring that their employees have been health and safety trained in accordance providing evidence of medical surveillance and medical approviding evidence of medical surveillance and medical evidence of medical surveillance and medical evidence of medical	not responsible for its use by others. The plan onditions, purposes, tasks, dates and personnel we plan must be utilized and reviewed by those disafety of their employees and shall comply with all applicable v) and (v), Battelle will inform subcontractors of the site plosion, health, safety or other hazards by making this Site need by others available during regular business hours. All eloping their own Health and Safety Plan including a written pard specific programs required by federal, state and local laws are equipment (PPE); (3) providing documentation that their complicable federal, state and local laws and regulations; (4) provals for their employees; and (5) designating their own site ployees comply with their own Health and Safety Plan and taking
any other additional measures required by their site activities SECTION 2: PROJECT INFORMATION	es.
(1) SITE INFORMATION Site OU16 (Site 89) Former DRMO Name: Site Address Camp Lejuene, North Carolina 28542	Site Project Contact: Daniel Hood Phone Number: 757-322-4630 Site Safety & Health Contact: Phone Number Sam Yoon 614-424-4569/614-537-5658
(2) SITE CLASSIFICATION (check or circle all that apply) √ Hazardous (RCRA/CERCLA/State) Construction Landfill (Non-Hazardous) UST/LUST Manufacturing Active √ Inactive Other: military installation	(3) ENTRY OBJECTIVES (check or circle all that apply) √ Site Inspection (General) □ Well Drilling Observation □ Sampling, Air √ Sampling, Water √ Sampling, Soil □ Other: □ DATE(S) OF FIELD VISIT(S):
(4) BATTELLE/ASU TASKS B1. Groundwater Investigation B2. Groundwater sampling B3. Water level survey and slug tests B4. Analytical activities	TASK PERFORMED BY OTHERS 01. Direct push activities for gw sample collection 102. IDW disposal 03. 04.
project job functions on site. (Note: One person may carry PRINCIPAL INVESTIGATORS Bru	The following personnel are designated to carry out the stated y out more than one job function.) acce Alleman/Paul Johnson m Yoon

		FERNATIVE SITE SAFE	ETY	Jennifer Triple	tt/Paul Dahi	len			
		FICER(S) BLIC INFORMATION O	FFICER	N/A	N/A				
		E RECORD KEEPER	TTICLK		Sam Yoon/Jennifer Triplett				
		E PERSONNEL WITH C	DR/FA	Sam Yoon	inici impici				
	511	ETERSONNEE WITH C	Sam 100n						
	FIE	LD TEAM LEADER(S)		Sam Yoon					
	OTI	HER FIELD TEAM MAN	NAGERS						
				-					
(6)	ON	SITE CONTROL							
(0)			ated to coor	dinate access control and sec	urity for Bat	telle operations on site. A safe perime	ter has been		
				g the work area with traffic c					
	No	unauthorized person shou	ld be within	this area.					
	The	on site Command Post ar	nd staging a	rea have been established at	the former l	ERH treatment area at Site 89 (OU16).			
						determine daily wind directions. The Cent exposure should a release occur.	Command		
	Cor	itrol boundaries have beer	established	l and include southern portic	on of OU16	. These boundaries are identified in th	e field by:		
		fic cones and/or high-visit			11 01 0 0 10	These soundaries are identified in th	ie field by.		
SECTI		PHYSICAL HAZ		1					
(1)	IDE	ENTIFY POTENTIAL PH	YSICAL H	AZARDS TO WORKERS (check or circ	cle all that apply)			
		Confined Space		Steep/Uneven Terrain		√ Drums Handling*			
	\checkmark	Heavy Equipment		Heat Stress	[Noise			
		Moving Parts	$\sqrt{}$	Extreme Cold	[Non-Ionizing Radiation			
		Heavy Lifting		Ionizing Radiation	[Other:			
		Electrical		Traffic					
		Overhead Hazards		Biological Hazards					
		Fall (>6; Vertical)		Surface Water (Immersion)					
		ll be mitigated by:	1 1 1	. 11 1 141 4					
	1) Brie 2) Ider	eting site personnel as to intifying the "kill switch" of	dentified ph	ysical hazards within the wor	k area.				
				r muffs, ear plugs, winter jak	ets etc will	be don to site personnel			
,						ded in the first aid kit for insect stings.			
(2)				R BATTELLE/ASU EMPLO		ck or circle all that apply)			
		Explosimeter		Eye Wash		Confined Space Warning Signs			
		Fall Protection		Emergency Shower	$\sqrt{}$	Communications – On Site			
	V	Equipment Barrier Tape	$\sqrt{}$	Emergency Air Horn	$\sqrt{}$	Communications – Off Site			
	V	Traffic Cones		Lights	∨	Other:			
		Stretcher		Lights – emergency	Ш	outer.			
	$\sqrt{}$	First Aid Kit		Ladder			_		
		A-B-C- Fire	√ √	Tick Repellant			_		
		Extinguisher	•	Tiek Rependin					
		Snake Bite Kit		Flotation Device (USCG Ty III)	pe		_		
				111)					
Emerg	encv eau	ipment will be located in	the cab of the	he drilling rig. See Sections 1	0 and 12 fo	or communication procedures. The field	d crew will		
				and emergency air horn for c					
SECTI	ON 4:	CHEMICAL HAZ	ZARDS INF	ORMATION					
(1)	IDE	ENTIFIED CONTAMINA	NTS						
	Known	or suspected hazardous/to	xic material	(attached historical informat	ion, physica	l description, map of contamination an	d		
		d date, if available).			/I J	1 / 1			
			tances Invol	ved Character	istics	Estimated	PEL		
	CW	au :	. 1	110 170		Concentrations			
	GW	Chlorin hydroca		VO and TO		As much as 18,900 μg/L during the ERH			
		nydroca	11 00115			operation			

ER-0314 9 Appendix D

	SL		O and TO	520 mg/kg of TCE
		hydrocarbons		
	Media types	gas) OT (other).	quid), WS (waste, solid), WD	(waste, sludge), WG (waste,
	Characterizations	CA (corrosive, acid) CC, (corrosive, toxic), RE (reactive), BIO (infect	ve, caustic), IG (ignitable), RA	A (radioactive), VO (volatile), TO
		eets (MSDSs) for the contaminants of	of concern are attached. The c	lata sheets include information on
(2)	the chemical/toxicologic	cal properties of the site contaminant	s and signs and symptoms of	over exposure. H OF THE BATTELLE/ASU TASKS LISTED
(2) IN SE	EC 2.4:	NIIAL FOR CONTACT WITH EAC	TH MEDIA TYPE FOR EAC	H OF THE BATTELLE/ASU TASKS LISTED
11,02	BATTELLE TASK #	ROUTE OF EXPOSURE	POTENTIAL FOR CONTACT	METHOD OF CONTROL
	B1	Inhal/Ingest/Contact/Absorb	High/Medium/Low	Level D PPE
	B2	Inhal/Ingest/Contact/Absorb	High/Medium/Low	
	B3	Inhal/Ingest/Contact/Absorb	High/Medium/Low	
	B4 The SSO will brief th	Inhal/Ingest/Contact/Absorb ne field team on interpretation of the	High/Medium/Low	
	over exposure to che		attached WisDos and particula	arry on symptoms and signs of
SECT		D COMMUNICATION PROGRAM	1	
	Battelle Hazardous	roduced to the site by Battelle (e.g., o Communication Program and associ The current list of chemicals for this	ate MSDSs to the site. The SS	ervatives, etc.), bring a copy of the SO will review this information with
	1,1,2-Trichloroetha	ne	Alcohol	
	1,1,2,2-Tetrachloro		Trichloroethene	
	HCL (preservative)		Tetrachloroethene	(
	Liquinox®		1,2-dichloroethene (chloride	(cis- and trans-), Vinyl
			CHIOTIGE	
SECT	TON 6: ENVIRO	ONMENTAL MONITORING		
(1)			all be used on site at the speci	fied intervals for breathing zone monitoring:
(1)	The following clivin	omicital monitoring instruments sir	an oc used on site at the speci	ned intervals for oreatining zone mointoring.
	EQUIPMENT Combustible Gas	MONITORING PER	IOD	ACTION LEVEL
	Indicator	daily/hourly/continuous	s/other	
	O ₂ Meter	daily/hourly/continuous		
	PID (Lamp10.6_			
	eV)	daily/hourly/continuous		
	FID	daily/hourly/continuous	s/other	
	Radiation Meter	4-:1/11/4:	-/-41	
	(Gamma) Respirable Dust Meter	daily/hourly/continuous daily/hourly/continuous		
	GC/ECD/FID	daily/hourly/continuous		<u> </u>
□ √	GC/FID/PID/DELCD	daily/hourly/continuous		
•	GC/TID/TID/DEECD	daily/hourly/continuous		
(2)	Monitoring equipme	ent is to be calibrated according to the		daily prior to and after each day of
		tion data and air concentration in the		
(3)		ork shutdown and excavation. These of highly toxic compounds from the		eration should be given to the oducts. Levels are for persistence (>
	10 111111).			ACTION LEVEL
	Uncharacterized Ai	rborne Vapors or Gases		>Background
	Characterized Airbo	orne Gases, Vapor,		>50% PEL, REL,
	Particulates			TLV
	Oxygen			< 19.5; >23.5
(4)	Flammability Military and/or civi	lian personnel in charge of buildings	adjacent to invasive monitori	> 10% LEL
(4)		ck-off meeting of site activities. A c		
		area as described above or if discern		
	in charge or their de	esignated representative will be notifi-	ied immediately. Hourly period	meter monitoring (support zone)
		assess whether organic vapors or or		

NAME	MEDICAL		INITIAL	VOPPER TR	REFRESHER	CPR/FA/
NAME	(Date)		(Hrs/Date)		(Date)	(Dates)
Sam Yoon	Feb 2005		40 hours/Jan 16, 1997]	June 17, 2005	8/25/2005; 6/27/2003 (good for 3 years)
Shane Waltor	Nov 2004		40 hours/April 1994		January 13, 2006	10/27/2005; 5/28/2004 (good for 3 years)
Jennifer Triplett			40 hours/June 2001		August 7, 2005	
Paul Dahlen			40 hours/Nov 1992	(Anuary, 2005 Refresher sched. For Feb 2006)	
CTION 8:	PERSONAL MONITOR	INC				
	No personal exposure momentum is anticipated	onitoring or , this HASP			e place on site. If the	need for such
ECTION 9:	CONFINED SPACE EN No confined space and/or exists, this HASP will be	r trench entr		ite. If the po	ssibility of such entri	es taking place
ECTION 10:	COMMUNICATION PR					
	ollowing standard hand signals			adio commun	ications in each conta	aminant
	ion zone:	Will of abou			reactions in each conta	
пан	d gripping throat			Can't Ta	lk, Having difficulty	breathing
		ls around wr	rist		lk, Having difficulty lk, Leave area immed	
Grip	partner's wrist and both hand	ls around wr	rist		lk, Leave area immed	
Gri _l Han		ls around wr	rist	Can't Ta Need ass	lk, Leave area immedistance	diately
Grip Han Thu Thu	o partner's wrist and both hand ds on top of head mbs up mbs down			Can't Ta Need ass OK, I an No, nega	Ilk, Leave area immed sistance n all right, I understar ttive	diately
Grip Han Thu Thu If appl and/or when The con is	o partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicat mobile phone number(s) will these numbers are available. nmand post telephone 757-	tions to the C	Command Post Should	Can't Ta Need ass OK, I an No, nega be Establishe	alk, Leave area immedistance in all right, I understantive and as soon as possible	diately and
Grip Han Thu Thu If appl and/or when The con is	o partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicat mobile phone number(s) will these numbers are available.	ions to the O	Command Post Should	Can't Ta Need ass OK, I an No, nega be Establishe	alk, Leave area immedistance in all right, I understantive and as soon as possible	diately and
Grip Han Thu Thu If appl and/or when to The con is The motis	o partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicate mobile phone number(s) will these numbers are available. nmand post telephone 757-bile phone	be available	Command Post Should e one week prior to the	Can't Ta Need ass OK, I an No, nega be Establishe	alk, Leave area immedistance in all right, I understantive and as soon as possible	diately and
Grip Han Thu If appl and/or when The con is The mol is ECTION 11: Persor constr Modif (1)	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicat mobile phone number(s) will these numbers are available. mmand post telephone 757-bile phone DECONTAMINATION mel and equipment leaving an ucted at the command post. Tied Level D decontamination properties of the properties of the partners of the partner	PROCEDU exclusion z he SSO is reprotocol sha	Command Post Should e one week prior to the RES one shall be thoroughl esponsible for monitor ll be used with the foll	Can't Ta Need ass OK, I an No, nega be Establish start of field	alk, Leave area immedistance in all right, I understantive ed as soon as possible work. The HASP wi	diately nd a. The stationary ill be amended
Grip Han Thu If appl and/or when the consis The most is ECTION 11: Persor constr Modifi (1) (2)	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicat rombile phone number(s) will these numbers are available. Inmand post telephone 757-bile phone DECONTAMINATION and and equipment leaving an ucted at the command post. The Level D decontamination is Equipment Drop (IF NECES Boot Covers, and Glove Was NECESSARY)	PROCEDU exclusion z he SSO is reprotocol sha SSARY) sh and Rinse	Command Post Should e one week prior to the RES one shall be thoroughl esponsible for monitor ll be used with the foll e (IF	Can't Ta Need ass OK, I an No, nega be Establish start of field	alk, Leave area immedistance in all right, I understantive ed as soon as possible work. The HASP wi	diately nd The stationary Ill be amended
Grip Han Thu If appl and/or when to The cont is The moti is ECTION 11: Persor constr Modifi (1) (2)	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicat rombile phone number(s) will these numbers are available. In these numbers are available numand post telephone 757-bile phone DECONTAMINATION and and equipment leaving an ucted at the command post. The Level D decontamination produpted the Level D decontamination produpted to the command post. See Boot Covers, and Glove Was NECESSARY) Outer Boot and Glove Remo	PROCEDU exclusion z he SSO is reprotocol sha SSARY) sh and Rinse wal (IF NEC	RES one shall be thoroughl esponsible for monitor ll be used with the foll e (IF	Can't Ta Need ass OK, I an No, nega be Establish start of field	alk, Leave area immedistance in all right, I understantive ed as soon as possible work. The HASP wi	diately nd a. The stationary ill be amended
Grip Han Thu If appl and/or when the consis The most is ECTION 11: Persor constr Modiff (1) (2)	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicate mobile phone number(s) will these numbers are available. In the phone mand post telephone 757-bile phone DECONTAMINATION and and equipment leaving an ucted at the command post. The lad Level D decontamination produced to the command post. The lad Level D decontamination produced to the command post. Some Covers, and Glove Was NECESSARY) Outer Boot and Glove Remo Outer Garment Removal (IF	PROCEDU exclusion z he SSO is reprotocol sha asSARY) sh and Rinse oval (IF NEC NECESSAI	RES one shall be thoroughl esponsible for monitor ll be used with the foll e (IF	Can't Ta Need ass OK, I an No, nega be Establish start of field	alk, Leave area immedistance in all right, I understantive ed as soon as possible work. The HASP wi	diately nd The stationary Ill be amended
Grip Han Thu If appl and/or when the consis The most is ECTION 11: Persor constr Modifi (1) (2)	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicat rombile phone number(s) will these numbers are available. In these numbers are available numand post telephone 757-bile phone DECONTAMINATION and and equipment leaving an ucted at the command post. The Level D decontamination produpted the Level D decontamination produpted to the command post. See Boot Covers, and Glove Was NECESSARY) Outer Boot and Glove Remo	PROCEDU exclusion z he SSO is reprotocol sha asSARY) sh and Rinse oval (IF NEC NECESSAI	RES one shall be thoroughl esponsible for monitor ll be used with the foll e (IF	Can't Ta Need ass OK, I an No, nega be Establish start of field	alk, Leave area immedistance in all right, I understantive ed as soon as possible work. The HASP wi	diately nd The stationary Ill be amended
Grip Han Thu If appl and/or when the consis The mosts ECTION 11: Persor constr Modifi (1) (2) (3) (4) (5) (6)	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicate mobile phone number(s) will these numbers are available. In the phone mand post telephone 757-bile phone DECONTAMINATION and and equipment leaving an ucted at the command post. Tied Level D decontamination produced at the command for Equipment Drop (IF NECES BOOT COVERS, and Glove Was Not Cessary) Outer Boot and Glove Remo Outer Garment Removal (IF Inner Glove Removal (IF NECES)	PROCEDU exclusion z he SSO is reprotocol sha siSARY) sh and Rinse wal (IF NECESSARY	RES one shall be thoroughl esponsible for monitor ll be used with the foll e (IF CESSARY) RY)	Can't Ta Need ass OK, I an No, negs be Establish start of field	alk, Leave area immedistance all right, I understantive ad as soon as possible work. The HASP wi	diately nd The stationary Ill be amended
Grip Han Thu If appl and/or when the consis The mosts ECTION 11: Persor constr Modifi (1) (2) (3) (4) (5) (6)	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicat rombile phone number(s) will these numbers are available. In these numbers are available. In mand post telephone 757-bile phone DECONTAMINATION and and equipment leaving an ucted at the command post. The Level D decontamination produced at the command post. The Level D decontamination produced at the command post. The Level D decontamination produced at the command post. The Level D decontamination produced at the command glove Was NECESSARY) Outer Boot and Glove Remo Outer Garment Removal (IF Inner Glove Removal (IF NEField Hand Wash)	PROCEDU exclusion z he SSO is reprotocol sha siSARY) sh and Rinse wal (IF NECESSARY	RES one shall be thoroughl esponsible for monitor ll be used with the foll e (IF CESSARY) RY)	Can't Ta Need ass OK, I an No, negs be Establish start of field	alk, Leave area immedistance all right, I understantive ad as soon as possible work. The HASP wi	diately nd The stationary Ill be amended
Grip Han Thu If appl and/or when to is The con is The mol is ECTION 11: Persor constr Modif (1) (2) (3) (4) (5) (6) The fo	p partner's wrist and both hand ds on top of head mbs up mbs down licable, telephone communicated mobile phone number(s) will these numbers are available. In mand post telephone mand post telephone 757-bile phone DECONTAMINATION and and equipment leaving an ucted at the command post. The Level D decontamination part Equipment Drop (IF NECES Boot Covers, and Glove Was NECESSARY) Outer Boot and Glove Remo Outer Garment Removal (IF Inner Glove Removal (IF NEField Hand Wash Illowing decontamination equipment equipment properties of the properties of the part of the pa	PROCEDU exclusion z he SSO is reprotocol sha SSARY) sh and Rinse wal (IF NECESSARY pment is required)	Command Post Should e one week prior to the e one week prior to the e one shall be thoroughlesponsible for monitor. Il be used with the foll the (IF CESSARY) (RY) (RY) (IF CESSARY) (RY) (RY) (RY) (RY) (RY) (RY) (RY) (Can't Ta Need ass OK, I an No, nega be Establish start of field y decontamin ng adherence owing decontamin	alk, Leave area immedistance all right, I understantive as soon as possible work. The HASP wi ated at the decontamic with this decontamic amination stations:	diately and The stationary amended The stationary amended The amended The amended The station facility anation plan. A

ER-0314 11 Appendix D

SECTION 12: EMERGENCY PROCE			
	ving standard emergency procedures. The SSO shall ensuring that the procedures are followed.	be notified	d of any on site
Personal Injury in the	DESIGNATED EMERGENCY SIGNAL:	Ai	r Horn
Exclusion Zone	SIGNAL.		
assemble at the decontamination line. The should be decontaminated to the extent p initiate the appropriate first aid, and conta	usion Zone, the designated emergency signal shall be the SSO or alternate should evaluate the nature of the it possible prior to movement to the Support Zone. The fact should be made for an ambulance (and other emer quired). No persons shall reenter the Exclusion Zone	njury, and on site CPI gency serv	the affected person R/FA personnel shall rices as needed) and
Fire/Explosion	DESIGNATED EMERGENCY SIGNAL:	Ai	r Horn
	n site, the designated emergency signal shall be sound the fire department shall be alerted and all personnel		
If any other equipr	nent (i.e., air monitoring) or	า	
site fails to operate	properly, the Field Team		
Leader and SSO sh	nall be notified and then		
determine the effe	ct of this failure on continuir	ıa	
	If the failure affects the sa	_	
•	events completion of the Wo	•	
•	onnel shall leave the Exclusi		
<u>-</u>	ation is evaluated and		
appropriate actions			
	, taken.		
Emergency escape routes are designated the decontamination line	for use in those situations where egress from the Excl	usion Zon	e cannot occur through
In all situations, when an on site emergence	y results in evacuation of the Exclusion Zone, person	nel shall n	ot reenter until:
(1) The conditions resulting in the eme(2) The hazards have been reassessed been reassed been reassessed been			
(3) The Site Safety Plan has been revie	wed by the SSO and Corporate Health and Safety Ma	ınager.	
SECTION 13: SPILL CONTROL PRO		agomy If t	ha maasihility af ayah
	or solids exist on site, and no spill control plan is nece this HASP will be modified accordingly.	essary. 11 t	ne possibility of such
SECTION 14: EMERGENCY INFOR			
(1) LOCAL RESOURCES			
Ambulance (name):	Onslow Memorial Hospital Ambulance	Phone:	911
Hospital (name):	Onslow Memorial Hospital	Phone:	911 or (910) 577-2345
Police (local or state): Fire (name):	MC Camp Lejeune Police MC Camp Lejeune	Phone: Phone:	911
HAZ MAT Responder:	National Response Center,	Phone:	911
	Toxic Chemicals and Oil Spills		
On-Site CPR/FA(s):	Sam Yoon	Phone:	614-537-5658
* For life-threatening emergencies or em- The above hospital is approximately 10	ergency trauma care. <u>miles</u> from the furthest work area and the ambulance	eresponse	time is approximately <u>15 minutes</u> .
** For non-life threatening medical care. The above hospital is approximately 30 treatment only. DIRECTIONS TO NEAREST HOSPIT (2) Figure 1.	minutes from the furthest work area. Injured worker FAL – SEE ATTACHED MAP:	rs will be to	ransported here for non-emergency

Site Contact:

Sam Yoon: 614-424-4569

BATTELLE RESOURCES

Manager, Corporate Health and Safety (ETE Division)

Gary Carlin, 614-424-4929						
Battelle Security Office (614) 424-4444						
SECTION 15: PERSONAL PR	OTECTIVE EQ	OUIPMENT (chec	ek or circle al	l that apply)		
☐ No type of respi	ratory protection		s site. If the		eed for re	espiratory protection
CLOTHING		GLOVES		BOOTS		OTHER
□ Coveralls	□ С	otton		Safety	$\sqrt{}$	Hard Hat
□ Tyvek	· .	eather		Fireman/Hip	$\sqrt{}$	Glasses
Saranex	•	itrile		Neoprene		Goggles
□ PE Tyvek		utyl	$\sqrt{}$	Steel Toe		Face Shield
Other:		eoprene			$\sqrt{}$	Hearing Protection
-		iton VC				
-	_	VA				
		atex				
SECTION 16: SAFE WORK F		atox .				
PLAN REVIEWED BY: H&S Manager: Principal Investigator Project Leader: Site Safety Officer: I acknowledge that I have roused as described and agree to come	uids within or the cavated material prohibited at all t and when collectin when collectin the cavated in outside letted outlets. The cavated in outside letted outlets are to be may be exposed use. The cavate was weather-related by the cavate was supported in the cavate was a cavate with the cavate was a	arough improvised ls, or other contamines. ing samples. where the kill switco ocations, wet area a ker is close enougaintained. to corrosive mater and working conditional conditions improved to corrosive mater and working conditional conditions improved to the contents of the plan for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in this HASP for other than the contents of the plan in the contents of the plan in this HASP for other than the contents of the plan in the contents o	I heating devininated materials. Ich is. Ich is, s, or near watch to render in the control of	ices (e.g., barrels) is rials must be minim ter must be plugged mmediate aid will buitable for quick dreinderstorm, limited priate protection from attached MSDSs. I	s forbidd ized. I into growe in effect enching continuity in the electric enchine in the electric enchine electric elect	ound fault circuit ct. or flushing shall be generate cold or ements is provided. DATE and the site hazards
FIELD PERSONNEL (Prin	: Name)	SIGI	NATURE			DATE
VISITOR (Print Nam	e)	SIG	NATURE			DATE
Organization/Agency						
Organization/Agency						

ER-0314 13 Appendix D

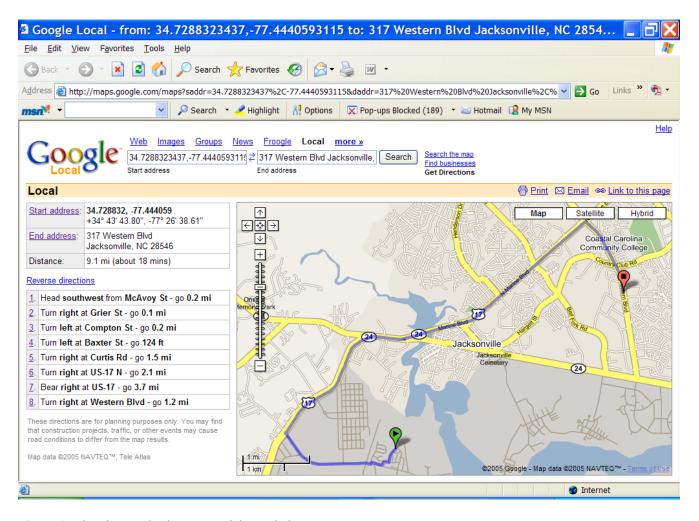


Figure 1. Directions to Onslow Memorial Hospital

Draft Final

Data Analysis Report Camp LeJeune – Site 89

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:

Arizona State University Battelle Memorial Institute

June 2006

The vendors and products, including the equipment, system components, and other materials	
identified in this report, are primarily for information purposes only. Although some of these vendors and products may have been used in the past, mention in this report does not constitute a recommendation for using these vendors or products.	

Contents

Figures 17
Tables 18
Acronyms and Abbreviations
1. Introduction 20
2. Field Investigation20
3. References 23
Figures
FIGURE 1. SITE MAP
FIGURE 2. DIRECT-PUSH LOCATIONS FIGURE 3. HYDRAULIC CONDUCTIVITY MEASUREMENT LOCATIONS
FIGURE 4. MONITORING WELL DEPTH-TO-WATER MEASUREMENTS AND GROUNDWATER
SAMPLING LOCATIONS
FIGURE 5. CROSS-SECTION OF DIRECT PUSH SAMPLING LOCATIONS
FIGURE 6. CHEMICAL-SPECIFIC MONITORING WELL CONCENTRATION DATA COMPARISON
FIGURE 7. 1,1-DICHLOROETHENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μG/L)
Figure 8. cis-1,2-Dichloroethene Direct-Push Groundwater Concentrations (μ G/L) Figure 9. 1,1,2,2-Tetrachloroethane Direct-Push Groundwater Concentrations

FIGURE 11. TRICHLOROETHYLENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μG/L)

 $(\mu G/L)$

- FIGURE 12. TETRACHLOROETHENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (µG/L)
- FIGURE 13. TRANS-1,2-DICHLOROETHENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS $(\mu G/L)$
- FIGURE 14. VINYL CHLORIDE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (µG/L)
- FIGURE 15. HYDRAULIC CONDUCTIVITY TEST DATA (CM/S) OVERLAIN ON TRICHLOROETHYLENE CONTOUR PLOT

Tables

- TABLE 1. GEOLOGIC DESCRIPTIONS OF CONTINUOUS SOIL CORES (FEBRUARY/MARCH 2006)
- TABLE 2. SAMPLING LOCATIONS AND TYPES OF TEST PERFORMED (FEBRUARY/MARCH 2006)
- TABLE 3. SLUG TEST RESULTS (FEBRUARY/MARCH 2006)
- TABLE 4. DEPTH-TO-GROUNDWATER FOR MONITORING WELLS (FEBRUARY/MARCH 2006)
- TABLE 5. WATER QUALITY DATA FOR MONITORING WELLS (FEBRUARY/MARCH 2006)
- TABLE 6. CHEMICAL CONCENTRATION DATA FOR MONITORING WELLS (FEBRUARY/MARCH 2006)
- Table 7. Chemical Concentration Data for Direct-Push Downgradient Transect Locations (February/March 2006)
- Table 8. Water Quality Data for Direct-Push Downgradient Transect Locations (February/March 2006)
- TABLE 9. FIELD DATA AND RESULTS FOR CONSTANT DRAWDOWN AQUIFER TESTING IN DIRECT-PUSH DOWNGRADIENT TRANSECT LOCATIONS (FEBRUARY/MARCH 2006)
- TABLE 10. MONITORING WELL CHEMICAL CONCENTRATION DATA COMPARISON

Acronyms and Abbreviations

bgs below ground surface

cis-1,2-DCE cis-1,2-dichloroethene

DELCD dry electrolytic conductivity detector

DO dissolved oxygen

EC electrical conductivity
ERH electrical resistance heating

ESTCP Environmental Security Technology Certification Program

FID flame-ionization detector

ft feet

GC gas chromatography

kg kilogram

NAPL non-aqueous phase liquid

ORP oxidation reduction potential

PID photo-ionization detector

temp temperature TCE trichloroethylene

VOA volatile organic analysis

yr year

1. Introduction

The post treatment field investigation of Camp LeJeune under ESTCP project CU-0314, *Critical Evaluation of State of In Situ Thermal Treatment Technologies*, was performed February 23 through March 3, 2006. Figure 1 identifies the extent of the previous electrical resistance heating (ERH) remediation area, which was also the specific area of interest for this particular field investigation.

Consistent with the objectives set forth under the CU-0314 Demonstration Plan, the field investigation at this site included the following:

- Verification of the site hydrogeological conceptual model
- Groundwater sampling of monitoring wells
- Depth-discrete analysis of hydraulic conductivity and dissolved petroleum hydrocarbons at temporary sampling locations downgradient of the treatment zone.

2. Field Investigations

In accordance with the approved generic demonstration plan for this project, the following sitespecific activities were conducted:

- (1) Verification of the site hydrogeological conceptual model:
 - a. For confirmation of geology, one continuous soil cores was collected at direct-push sampling locations GP1 shown in Figure 2. The continuous soil core/ direct-push sampling location was located at the down-gradient edge of the treatment zone. Table 1 presents qualitative geologic descriptions from visual observations of the continuous soil core.
 - b. Hydraulic conductivity slug testing was conducted in 14 monitoring wells as identified in Table 2 and in Figure 3. The slug test data were analyzed using both the Hvorslev and the Bouwer and Rice Methods; results are presented in Table 3. The Hvorslev' expression for determining hydraulic conductivity from slug test data is:

```
 \begin{split} &K \!\!=\!\! (r^2 ln(L_e/R))/(2L_e t_{37}) \\ &\text{Where} \quad K = \text{hydraulic conductivity (L/T)} \\ &\quad r = \text{radius of well casing (L) (0.083 \text{ ft})} \\ &\quad R = \text{radius of well screen (L) (0.50 \text{ ft})} \\ &\quad L_e = \text{length of well screen (L) (5 \text{ or } 10 \text{ ft})} \\ &\quad t_{37} = \text{time for water level to rise or fall } 37\% \text{ of the initial change (T)} \\ &\quad (\text{from data set}) \\ &\quad (\text{Fetter, 2000)}. \end{split}
```

The Bouwer and Rice expression for determining hydraulic conductivity from slug test data is:

```
\begin{split} &K \!\!=\!\! (r_c^2 \ln(R_e/R) \, / \, (2L_e)) * ((1/t) \ln(H_o/H_t)) \\ &Where \quad K = \text{hydraulic conductivity (L/T)} \\ &r_c = \text{radius of well casing (L) (0.083 ft)} \\ &R = \text{radius of gravel envelope (L) (0.50 ft)} \\ &R_e = \text{effective radial distance over which head is dissipated (L) (from data set)} \\ &L_e = \text{length of well screen (L) (5 or 10 ft)} \\ &H_o = \text{drawdown at t=0 (L) (from data set)} \\ &H_t = \text{drawdown at t=t (L) (from data set)} \\ &t = \text{time since H} = H_o (T) (\text{from data set})} \end{split}
```

- c. Depth-to-groundwater was measured in the 14 groundwater monitoring wells identified in Table 2 and in Figure 4. Depth-to-water measurements are summarized in Table 4.
- (2) Collection of water quality samples from 26 groundwater monitoring wells within the treatment zone for analysis of dissolved chlorinated hydrocarbon groundwater concentrations:
 - a. Table 2 identifies the groundwater monitoring wells from which samples were collected. Prior to sample collection, three well-volumes were purged. Groundwater was then collected for analysis of field parameters and stored in volatile organic analysis (VOA) vials for analysis of dissolved chlorinated hydrocarbon concentrations. General water quality field parameters including pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP) were measured using an Horiba U-22 meter. Petroleum hydrocarbon analysis was performed on-site by heated-headspace analysis and gas chromatography (GC) using a dry electrolytic conductivity detector (DELCD), photo-ionization detector (PID) and a flame-ionization detector (FID). General water quality data for permanent groundwater monitoring well installations can be found in Table 5 and chemical concentration data can be found in Table 6. All non-detect samples are listed as less than the detection limit.
- (3) Depth-discrete hydraulic conductivity and dissolved chlorinated hydrocarbon concentration data were collected on four foot intervals as possible from 3 ft below ground surface (bgs) to 40 ft bgs at all seven direct-push sampling locations.
 - a. Groundwater quality data were collected from depth-specific intervals at all direct-push sampling locations (See Table 2 and Figure 2). Sampling locations were spaced on approximately 50 ft centers, as possible, along a transect downgradient of the source zone and perpendicular to the direction of groundwater flow. Figure 2 presents the direct-push sampling locations. Using

percussion assisted direct-push technology and a modified Geoprobe Groundwater Profiler, groundwater samples were collected using a peristaltic pump on 4-ft intervals from 3 ft bgs to 40 ft bgs. The location of the depth-discrete groundwater samples are shown in Figure 5. Dissolved chlorinated hydrocarbon concentration analysis was conducted, as described above, and the results are summarized in Table 7. General water quality parameters (e.g. pH, EC, temp, DO, and ORP) were also collected during depth-specific sampling, and those data are presented in Table 8.

b. Aquifer specific-capacity tests were conducted at depth-specific intervals at direct push sampling locations GP1 through GP7 as indicated in Table 2 and Figure 3. Specific-capacity tests involve the measurement of the flow rate achieved under fixed drawdown and are analyzed using the Theim Equation to estimate hydraulic conductivity. The field data and results for aquifer testing are shown in Table 9. The Theim equation for hydraulic conductivity is:

```
T = (Q/(2(h_2-h_1))* \ln(r_2/r_1)
Where T = \text{transmissivity}(L^2/T)
Q = \text{pumping rate}(L^3/T)
h_1 = \text{head at distance } r_1 \text{ from the pumping well } (L)
h_2 = \text{head at distance } r_2 \text{ from the pumping well } (L)
and K = T/b
Where K = \text{hydraulic conductivity}(L/T)
b = \text{length of sampler or screen section}(L) \text{ (0.5 ft or length of screen)}
(Fetter, 2000).
```

The monitoring well chemical concentration data collected in February/March 2006 by the ASU/Battelle team were compared to the previous monitoring well chemical concentration data available for the site. The analytical results for each are shown in Table 10. The comparability of these results can also be seen in Figure 6 (a through g). Note that the ASU/Battelle February/March 2006 results for vinyl chloride appear higher than previous Site 89 results and low concentration values of cis-1,2-DCE also appear to be higher, but all other chemical concentrations are comparable. Also note that the analytical detection limit was used to plot Figure 6 (a through g) when an exact concentration was not provided and estimated values were used, if possible. The results of MW-20 are not provided in the monitoring well chemical concentration data because non-aqueous phase liquid (NAPL) was pumped from the well during the purging process.

Figures 7 to 14 present contour plots of the chemical concentrations for each of the eight chemicals measured at the depth-discrete direct push sampling locations. Figure 15 presents the specific capacity pump test results for each discrete-depth direct push sampling interval overlaid on the trichloroethylene (TCE) concentration plot.

A TCE mass flux calculation was performed using the Mass Flux Toolkit, Version 1.0. This program is a freeware program developed by Groundwater Services, Inc. and others under a contract funded by the Environmental Security Technology Certification Program (ESTCP). Figure 16 is a snapshot of the input screen with TCE being used to perform the mass flux analysis. A linear spatial and vertical interpolation of the data was used for the mass flux analysis. The TCE mass flux was estimated to be 3.34E+01 kg/yr.

3. References

Fetter, C.W. 2000. Applied Hydrogeology. 4th ed. Upper Saddle River, New Jersey: Prentice-Hall. pp.197-200.

Figures

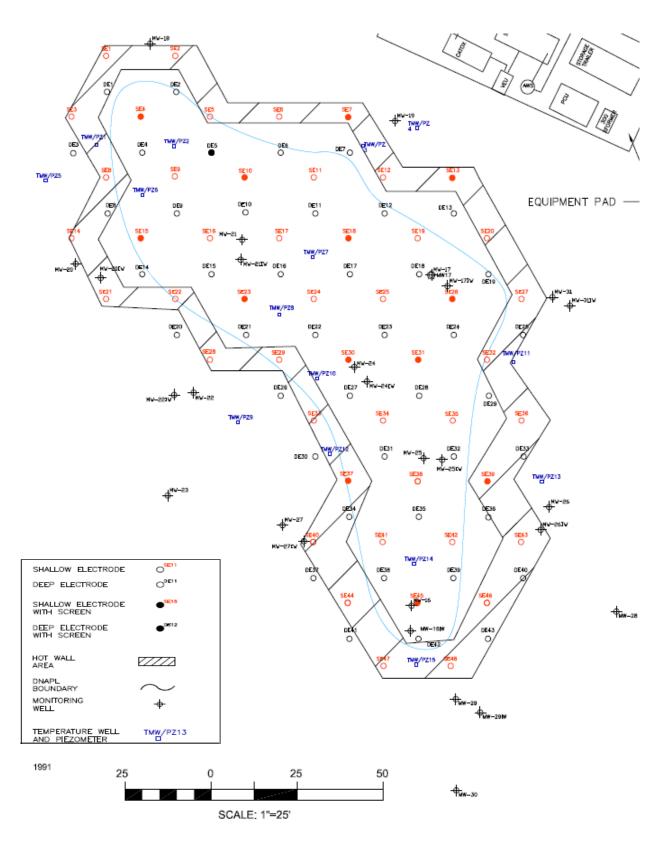


Figure 1. Site Map

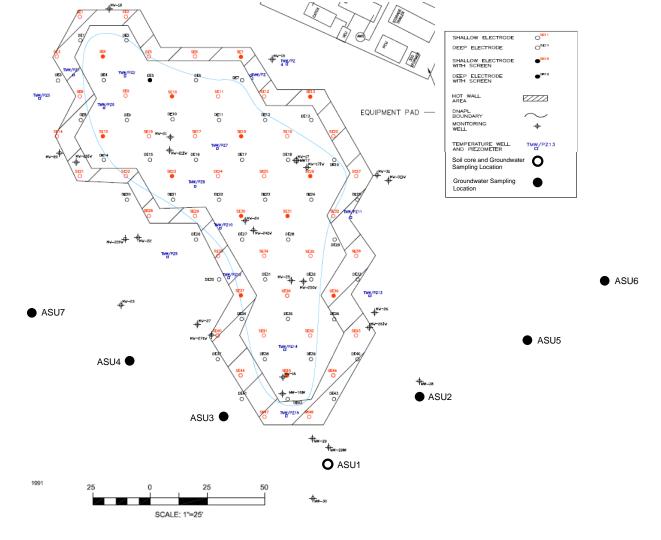


Figure 2. Direct-Push Locations

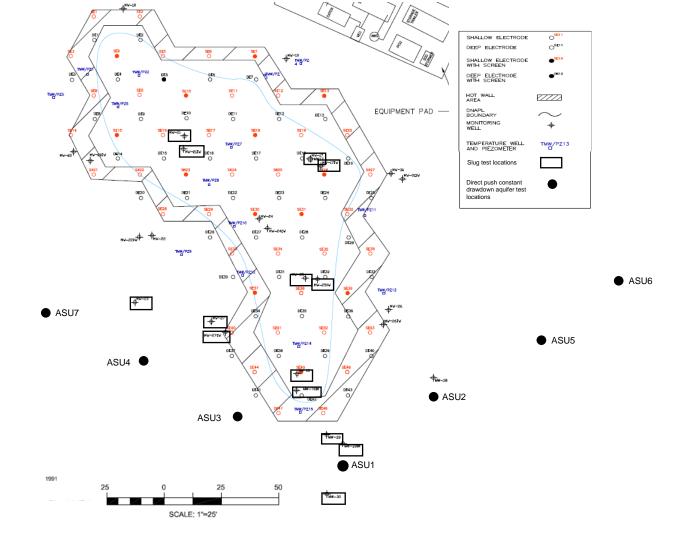


Figure 3. Hydraulic Conductivity Measurement Locations

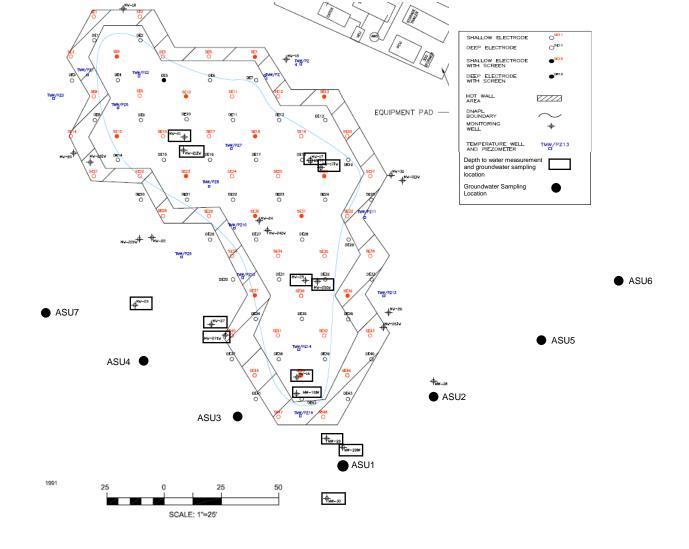
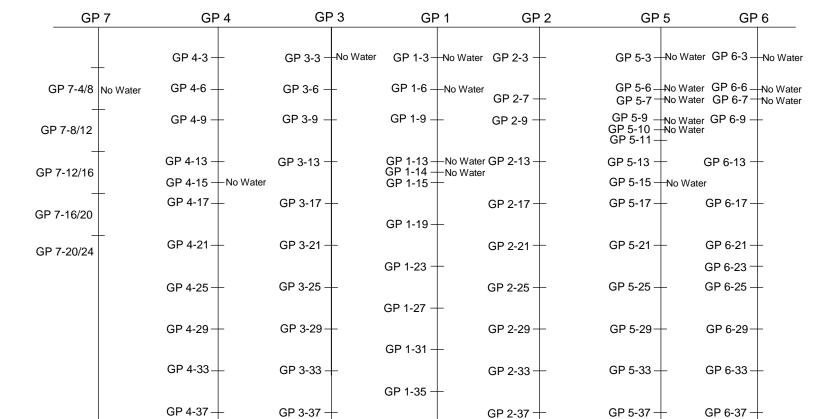


Figure 4. Monitoring Well Depth-to-Water Measurement and Groundwater Sampling Locations



GP 1-39 -

GP 3-40-

GP 4-40

Scale

1 inch =28 feet VE = 1/4

Figure 5. Cross-section of Direct Push Sampling Locations

GP 5-40 +

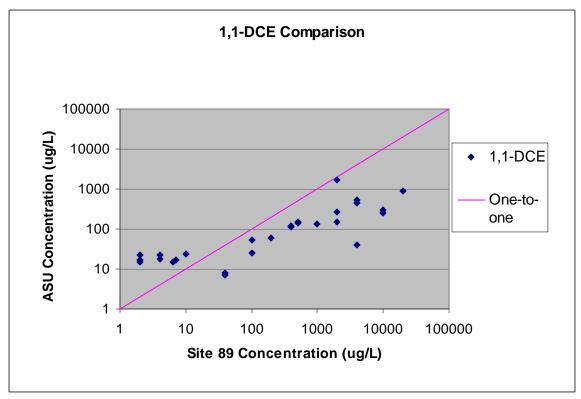


Figure 6(a)

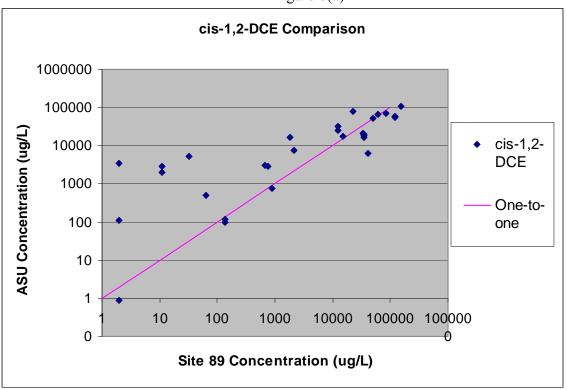


Figure 6(b)

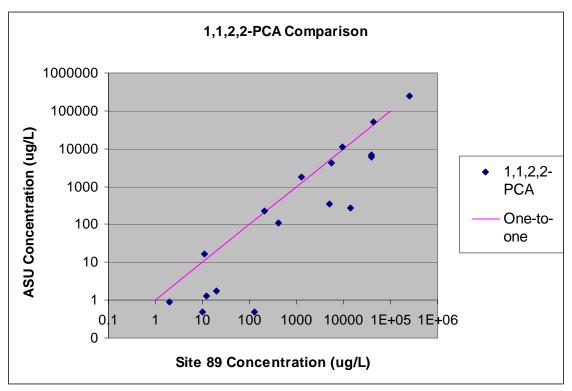


Figure 6(c)

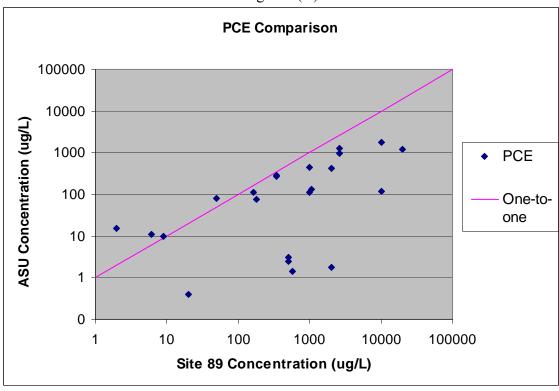


Figure 6(d)

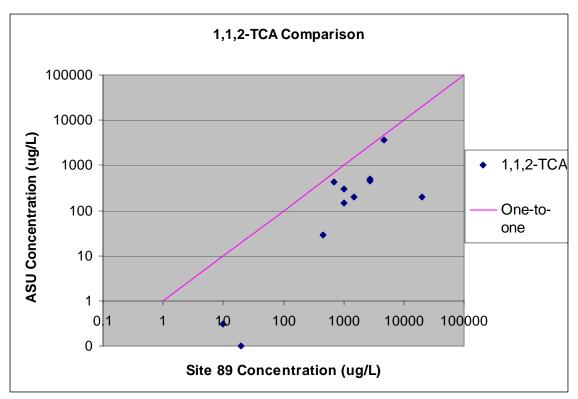


Figure 6(e)

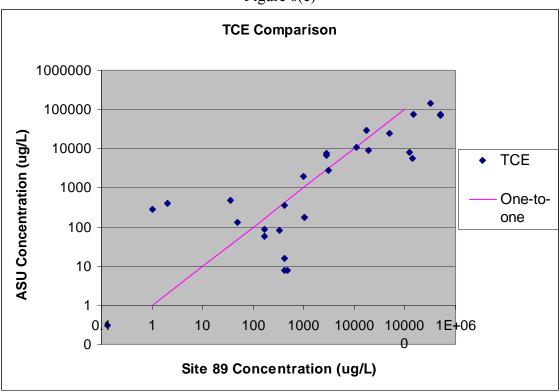


Figure 6(f)

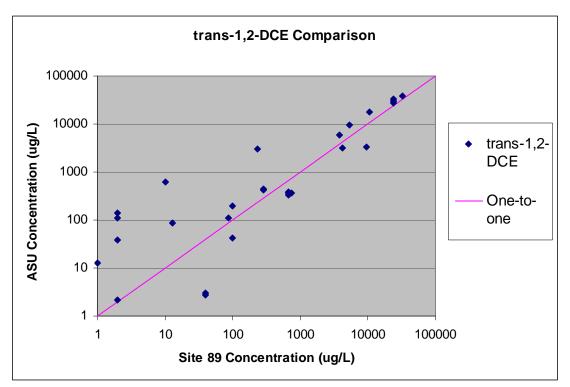


Figure 6(g)

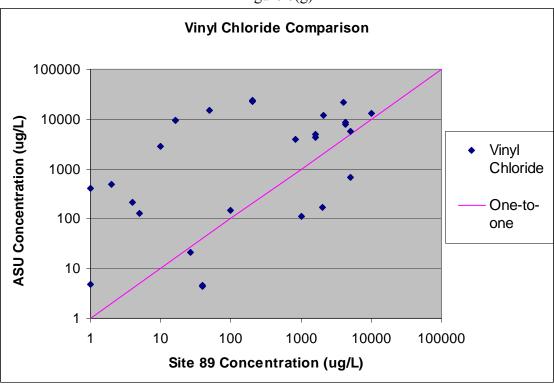


Figure 6(h)

Figure 6. Chemical-Specific Monitoring Well Concentration Data Comparison

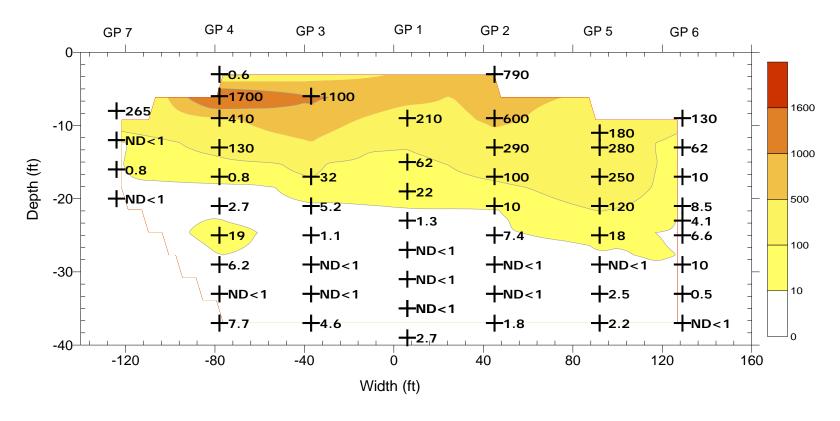


Figure 7. 1,1-Dichloroethene Direct-Push Groundwater Concentrations (µg/L)

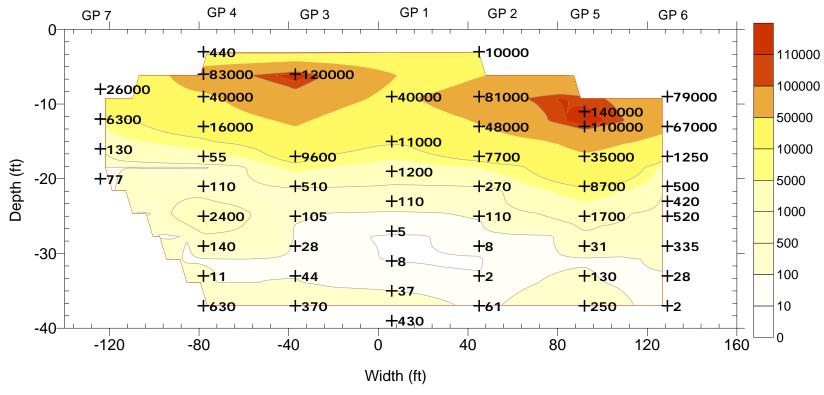


Figure 8. cis-1,2-Dichloroethene Direct-Push Groundwater Concentrations (µg/L)

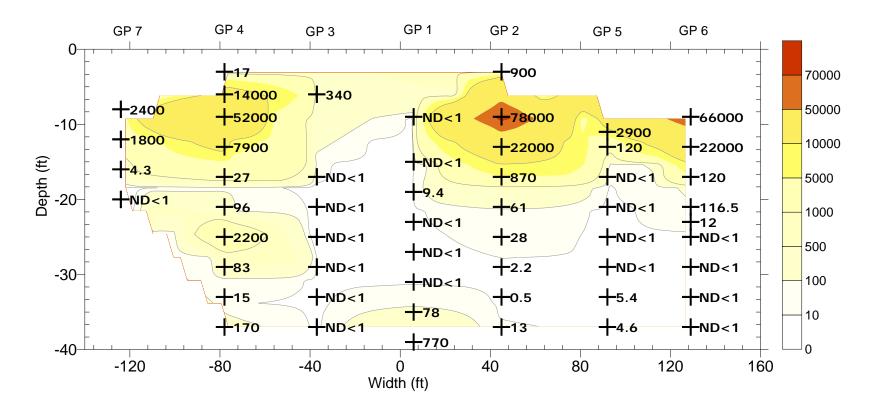


Figure 9. 1,1,2,2-Tetrachloroethane Direct-Push Groundwater Concentrations (µg/L)

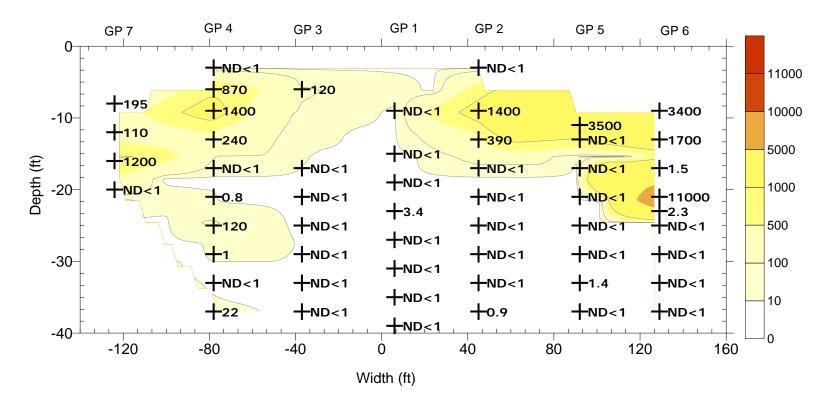


Figure 10. 1,1,2-Trichloroethane Direct-Push Groundwater Concentrations (µg/L)

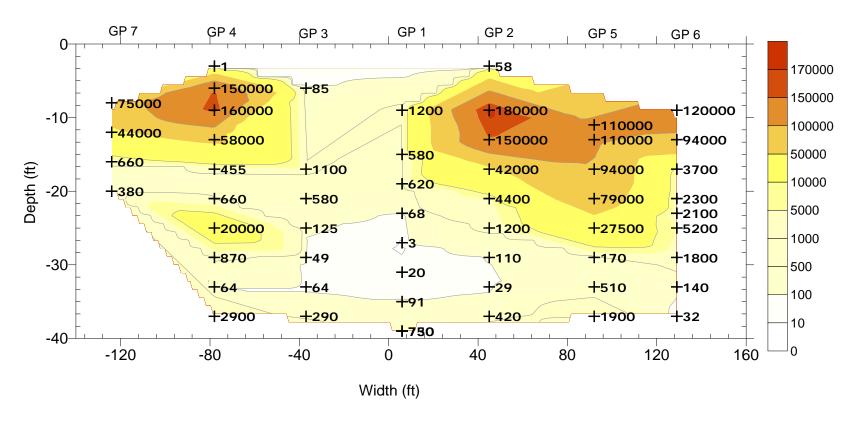


Figure 11. Trichloroethylene Direct-Push Groundwater Concentrations (µg/L)

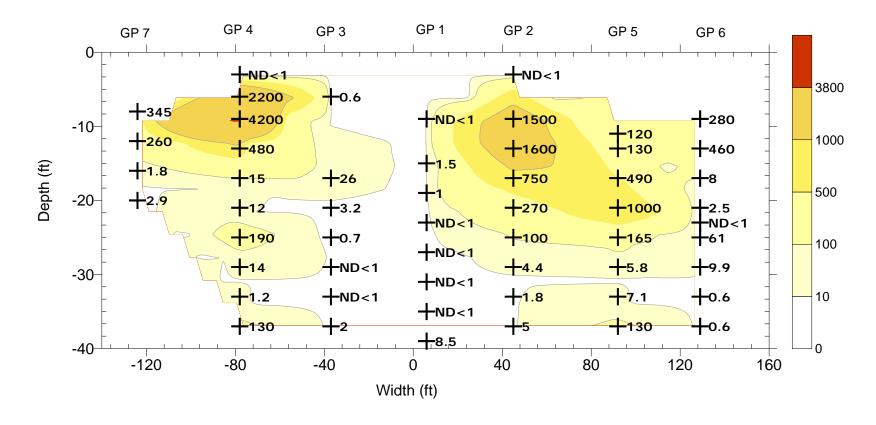


Figure 12. Tetrachloroethene Direct-Push Groundwater Concentrations (µg/L)

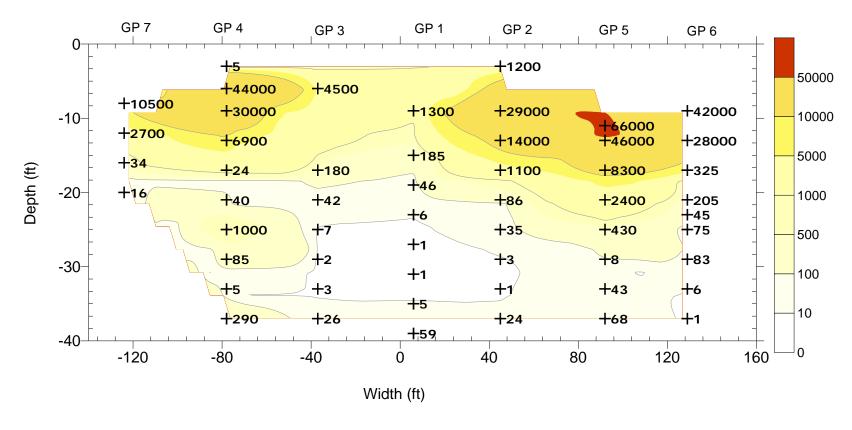


Figure 13. trans-1,2-Dichloroethene Direct-Push Groundwater Concentrations (µg/L)

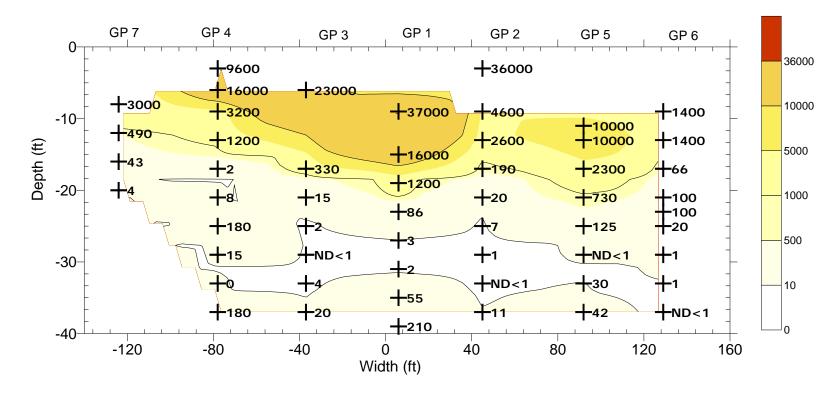


Figure 14. Vinyl Chloride Direct-Push Groundwater Concentrations (µg/L)

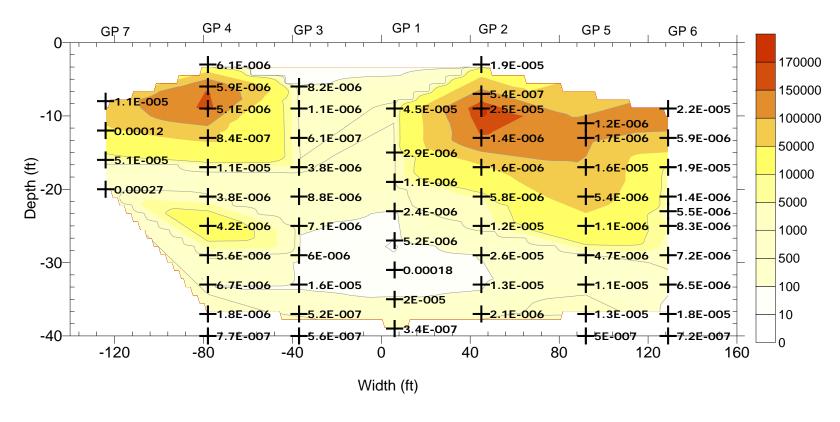


Figure 15. Hydraulic Conductivity Test Data (cm/s) Overlain on Trichloroethylene Contour Plot

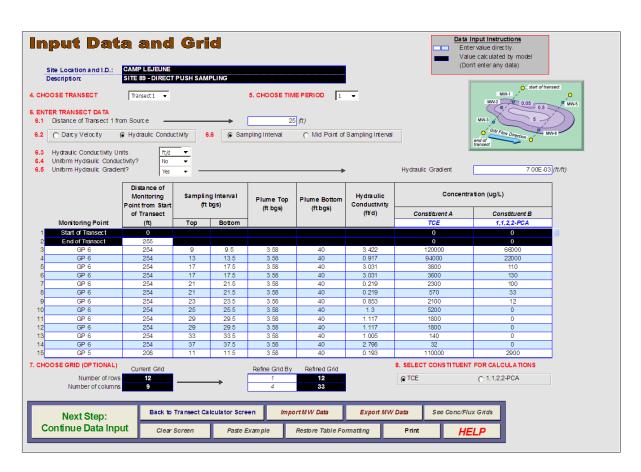


Figure 16. Mass Flux Toolkit Inputs

Tables

Table 1. Geologic Descriptions of Continuous Soil Cores (February/March 2006)

Boring Depth (ft)	Subsurface Features
	Continuous Soil Core GP 1
0-2	Silty find sand with some clay
4-5	Fine sandy silt with some clay
6-7	Clayey silt with some fine sands
8	Silty fine sand
9	Clayey silt with some fine sands
10	Fine sand
11-13	Silty fine sand
14	Silt
15	Sand and gravel with traces of clay
16-20	Sandy clay with fine to medium sand
22	Clay sands and gravels
24	Sands and gravels with some clay
26	Clayey sands with some gravel
28	Course sand with some clay
32	Sands and gravels with trace silts and clay
34	Clayey sands and gravel
36-40	Silty fine sands with some clay

Table 2. Sampling Locations and Types of Test Performed (February/March 2006)

Groundwater	Ph	ysical Assessn	Water Quality Assessment			
Monitoring Well or Direct- push Sampling Location	Depth-To- Water Measurement	Slug Testing	Constant Drawdown Aquifer Testing	Field Parameters ^c	Dissolved Petroleum Hydrocarbon Analysis	
MW-16	Yes	Yes		Yes	Yes	
MW-16IW	Yes	Yes		Yes	Yes	
MW-17	Yes	Yes		Yes	Yes	
MW-17IW	Yes	Yes		Yes	Yes	
MW-18				Yes	Yes	
MW-19				Yes	Yes	
MW-20				Yes	Yes	
MW-20IW				Yes	Yes	
MW-21	Yes	Yes		Yes	Yes	
MW-21IW	Yes	Yes		Yes	Yes	
MW-22				Yes	Yes	
MW-22IW				Yes	Yes	
MW-22				Yes	Yes	
MW-23	Yes	Yes		Yes	Yes	
MW-24				Yes	Yes	
MW-24IW				Yes	Yes	
MW-25	Yes	Yes		Yes	Yes	
MW-25IW	Yes	Yes		Yes	Yes	
MW-27	Yes	Yes		Yes	Yes	
MW-27IW	Yes	Yes		Yes	Yes	
MW-28				Yes	Yes	
MW-29	Yes	Yes		Yes	Yes	
MW-29IW	Yes	Yes		Yes	Yes	
MW-30	Yes	Yes		Yes	Yes	
MW-31				Yes	Yes	
MW-31IW				Yes	Yes	
GP-1*			Yes	Yes	Yes	
GP-2*			Yes	Yes	Yes	
GP-3*			Yes	Yes	Yes	
GP-4*			Yes	Yes	Yes	
GP-5*			Yes	Yes	Yes	
GP-6*			Yes	Yes	Yes	
GP-7*			Yes	Yes	Yes	

Water quality assessments and constant drawdown tests at direct-push locations were performed on 4-ft intervals from the phreatic surface (~3' bgs) to 40' bgs.
 Depth to water measurements are approximate and not intended for groundwater elevation

calculations.

^c Field parameters include: pH, electrical conductivity, temperature, dissolved oxygen, and oxidation reduction potential.

Table 3. Slug Test Results (February/March 2006)

Monitoring Well	Well Screen (ft)	Hvorslev K (cm/s)	Hvorslev K (ft/d)	Bouwer and Rice K (cm/s)	Bouwer and Rice K (ft/d)	
MW-16	5-15	2.76E-03	7.81	7.74E-04	2.19	
MW-16IW	20-25	5.70E-04	1.62	2.96E-04	0.84	
MW-17	5-15	4.59E-04	1.30	8.03E-05	0.23	
MW-17IW	20-25	3.75E-03	10.63	7.56E-04	2.14	
MW-21	5-15	2.05E-03	5.80	1.12E-04	0.32	
MW-21IW	20-25	2.79E-03	7.89	4.50E-04	1.28	
MW-23	5-15	3.16E-05	0.09	8.75E-06	0.02	
MW-25	5-15	6.89E-04	1.95	1.85E-04	0.52	
MW-25IW	20-25	1.87E-03	5.31	5.91E-04	1.67	
MW-27	5-15	6.82E-04	1.93	1.40E-04	0.40	
MW-27IW	20-25	1.30E-03	3.68	2.75E-04	0.78	
MW-29	5-15	8.13E-04	2.30	2.57E-04	0.73	
MW-29IW	20-25	1.68E-03	4.76	6.65E-04	1.88	
MW-30	5-15	5.87E-04	1.66	1.20E-04	0.34	

Table 4. Depth-to-Groundwater for Monitoring Wells (February/March 2006)

Monitoring Well	DTW (m BTOC)	DTW (ft BTOC)
MW-16	0.58	1.89
MW-16IW	0.87	2.85
MW-17	1.53	5.00
MW-17IW	1.66	5.43
MW-21	1.65	5.43
MW-21IW	1.79	5.88
MW-23	1.11	3.64
MW-25	1.36	4.46
MW-25IW	1.35	4.41
MW-27	1.09	3.58
MW-27IW	1.11	3.65
MW-29	0.65	2.13
MW-29IW	0.70	2.30
MW-30	0.55	1.80

DTW - Depth-to-water BTOC - Below top of casing

Table 5. Water Quality Data for Monitoring Wells (February/March 2006)

Monitoring Well	Water Quality Data ^a								
Womtoring wen	pН	EC (mS)	Temperature (°C)	DO (mg/L)	ORP (mV)				
MW-16	6.9	1.40	10.8	1.2	-199				
MW-16IW	7.1	0.59	14.3	0.8	-166				
MW-17	5.4	3.24	18.2	1.8	-178				
MW-17IW	6.7	0.56	22.7	1.7	-147				
MW-18	5.5	2.12	7.6	1.0	2				
MW-19	5.0	1.05	9.9	1.1	164				
MW-20									
MW-20IW	6.7	0.71	7.1	0.0	-127				
MW-21	6.0	8.70	7.1	0.7	-99				
MW-21IW	6.8	1.90	9.0	0.7	-153				
MW-22	6.0	3.61	10.6	0.3	-56				
MW-22IW	6.6	0.65	9.5	0.0	-133				
MW-23	6.6	2.00	3.7	1.6	-40				
MW-24	6.1	3.26	10.2	0.0	-114				
MW-24IW	6.8	0.78	15.1	0.5	-131				
MW-25	6.2	4.05	17.5	1.1	-107				
MW-25IW	7.0	0.78	20.2	1.2	-124				
MW-27	6.3	1.60	6.4	0.6	-15				
MW-27IW	6.8	0.70	8.9	0.8	-122				
MW-28	5.7	2.60	14.5	1.0	-81				
MW-29	6.9	1.20	9.8	0.5	-126				
MW-29IW	7.1	0.60	11.6	0.5	-135				
MW-30	7.0	0.89	7.9	1.3	-130				
MW-31	5.8	1.04	11.7	1.6	24				
MW-31IW	6.2	1.80	13.0	1.6	-123				

^a All measurements were made with a Horiba U-22 meter.

EC = electrical conductivity DO = dissolved oxygen

ORP = oxidation-reduction potential

Table 6. Chemical Concentration Data for Monitoring Wells (February/March 2006)

Monitoring Well	Date	Concentration (ug/L)								
Widnitoring Wen	Analyzed	Vinyl Chloride	1,1-DCE	trans-1,2-DCE	cis-1,2-DCE	TCE	1,1,2-TCA	PCE	1,1,2,2-PCA	
MW-16	2/26/06	24000	110	330	16000	360	ND <1	ND <1	110	
MW-16	3/3/06	23000	120	370	19000	16	ND <1	ND <1	ND <1	
MW-16IW	2/26/06	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	
MW-16QC	3/3/06	23000	120	380	20000	8	ND <1	ND <1	ND <1	
MW-17	2/26/06	150	59	3000	16000	2000	28	1	220	
MW-17IW	2/26/06	21	25	42	740	2800	0	82	1	
MW-18	3/1/06	670	250	33000	71000	140000	3600	1800	240000	
MW-19	3/1/06	110	150	5800	17000	30000	420	410	51000	
MW-20	NA			DNA	PL present in well					
MW-20IW	3/3/06	210	15	13	510	130	ND <1	10	17	
MW-21	2/27/06	9500	17	110	2900	82	ND <1	0	1	
MW-21IW	2/27/06	500	23	39	2000	57	ND <1	77	ND <1	
MW-21QC	2/27/06	9300	18	110	2900	86	ND <1	ND <1	ND <1	
MW-22	3/3/06	22000	1700	38000	110000	5700	300	130	270	
MW-23	2/27/06	4400	440	28000	56000	72000	460	960	6000	
MW-23	3/3/06	5000	520	30000	59000	75000	510	1300	6900	
MW-24	3/3/06	15000	54	200	7600	8	ND <1	0	ND <1	
MW-24IW	3/3/06	400	22	140	3500	400	ND <1	11	ND <1	
MW-25	2/26/06	2900	15	88	3100	0	ND <1	ND <1	2	
MW-25IW	2/26/06	130	24	610	5200	480	ND <1	110	1	
MW-27	2/27/06	13000	910	9700	80000	74000	200	1200	4200	
MW-27IW	2/27/06	5	8	3	120	180	ND <1	270	ND <1	
MW-27IW DUP	2/27/06	4	7	3	100	180	ND <1	290	ND <1	
MW-28	2/28/06	5700	300	3100	52000	8200	ND <1	120	340	
MW-29	2/27/06	12000	130	370	21000	9200	ND <1	110	ND <1	
MW-29IW	2/27/06	5	17	2	110	280	ND <1	15	1	
MW-30	2/28/06	7900	140	420	25000	6600	ND <1	2	ND <1	
MW-30 DUP	2/28/06	8600	150	440	32000	7600	ND <1	3	ND <1	
MW-31	3/1/06	170	40	3300	6400	24000	150	450	11000	
MW-31IW	3/1/06	4000	260	18000	66000	11000	200	2	1800	

DUP - Duplicate sample
REP - Quality control sample (second analysis of same water sample)
ND - non detect at the limit of 1 ug/L

Table 7. Chemical Concentration Data for Direct-Push Downgradient Transect Locations (February/March 2006)

Sampling			(Concentration	ı (ug/L)			
Location*	Vinyl Chloride	1,1 DCE	trans-1,2 DCE	cis-1,2 DCE	TCE	1,1,2 TCA	PCE	1,1,2,2 PCA
GP 1-9	37000	210	1300	40000	1200	ND<1	ND<1	ND<1
GP 1-15	17000	52	180	11000	620	ND<1	1	ND<1
GP 1-15	15000	72	190	11000	540	ND<1	2	ND<1
GP 1-19	1200	22	46	1200	620	ND<1	1	ND<1
GP 1-23	86	1	6	110	68	3	ND<1	ND<1
GP 1-27	3	ND<1	1	5	3	ND<1	ND<1	ND<1
GP 1-31	2	ND<1	1	8	20	ND<1	ND<1	ND<1
GP 1-35	7	ND<1	3	22	72	ND<1	ND<1	150
GP 1-35	110	ND<1	7	52	110	ND<1	ND<1	6
GP 1-39	210	3	60	430	730	ND<1	4	610
GP 1-39 QC	210	3	58	430	750	ND<1	13	930
GP 2-3	36000	790	1200	10000	58	ND<1	ND<1	900
GP 2-9	4600	600	29000	81000	180000	1400		78000
GP 2-13	2600	290	14000	48000	150000	390		22000
GP 2-17	190	100	1100	7700	42000	ND<1	750	870
GP 2-21	17	10	86	270	4400	ND<1		61
GP 2-25	7	7	35	110	1200	ND<1	100	28
GP 2-29	1	ND<1	3	8	110	ND<1	4	2
GP 2-33	ND<1	ND<1	ND<1	2	27	ND<1	2	ND<1
GP 2-33 QC	ND<1	ND<1	1	2	30	ND<1	2	1
GP 2-37	11	2	24	61	420	1	5	13
GP 3-6	23000	1100	4500	120000	85	120		340
GP 3-17	330	32	180	9600	1100	ND<1	26	ND<1
GP 3-21	15	5	42	510	580	ND<1	3	ND<1
GP 3-25	3	1	7	99	120	ND<1	1	ND<1
GP 3-25QC	1 ND 41	l ND 41	7 2	110	130	ND<1	l ND 41	ND<1
GP 3-29 GP 3-33	ND<1	ND<1 ND<1	3	28 44	49 64	ND<1 ND<1	ND<1 ND<1	ND<1 ND<1
GP 3-33 GP 3-37	20	ND~1	26	370	290	ND<1		ND<1
GP 3-37 GP 4-3	9600	1	5	440	290	ND<1		17
GP 4-6	16000	1700	44000	83000	150000	870		14000
GP 4-9	3200	410	30000	40000	160000	1400		52000
GP 4-13	1200	130	6900	16000	58000	240		7900
GP 4-17	1200	130	23	53	450	ND<1	15	32
GP 4-17QC	2	1	25	57	460	ND<1		22
GP 4-21	9	3	40	110				96
GP 4-25	180	19	1000	2400	20000	120		2200
GP 4-29	15	6	85	140	870	1	14	83
GP 4-33	1	ND<1	5	11	64	ND<1		15
GP 4-37	180	8	290	630	2900	22		170
GP 5-11	10000	180	66000	140000	110000	3500		2900
GP 5-13	10000	280	46000	110000	110000	ND<1	130	120
GP 5-17	2300	250	8300	35000	94000	ND<1		ND<1
GP 5-21	730	120	2400	8700	79000	ND<1	1000	ND<1
GP 5-25	130	18	430	1700	28000	ND<1	170	ND<1
GP 5-25QC	120	18	430	1700	27000	ND<1	160	ND<1
GP 5-29	2	ND<1	8	31	170	ND<1	6	ND<1
GP 5-33	30	3	43	130	510	1	7	5
GP 5-37	42	2	68	250	1900	ND<1		5
GP 6-9	1400	130	42000	79000	120000	3400	280	66000

Sampling		Concentration (ug/L)										
Location*	Vinyl Chloride	1,1 DCE	trans-1,2 DCE	cis-1,2 DCE	TCE	1,1,2 TCA	PCE	1,1,2,2 PCA				
GP 6-13	1400	62	28000	67000	94000	1700	460	22000				
GP 6-17	38	13	340	1300	3800	3	7	110				
GP 6-17	130	6	310	1200	3600	ND<1	9	130				
GP 6-21	100	5	190	740	2300	ND<1	0	100				
GP 6-21	31	12	220	260	570	11000	5	33				
GP 6-23	100	4	45	420	2100	2	ND<1	12				
GP 6-25	290	7	75	520	5200	ND<1	61	ND<1				
GP 6-29	20	10	81	350	1800	ND<1	10	ND<1				
GP 6-29QC	22	10	84	320	1800	ND<1	10	ND<1				
GP 6-33	1	1	6	28	140	ND<1	1	ND<1				
GP 6-37	1	ND<1	1	2	32	ND<1	1	ND<1				
GP 7-8	3000	270	11000	27000	76000	180	350	2400				
GP 7-8	2800	260	10000	25000	74000	210	340	2400				
GP 7-12	490	ND<1	2700	6300	44000	110	260	1800				
GP 7-16	43	1	34	130	660	1200	2	4				
GP 7-20	4	ND<1	16	77	380	ND<1	3	ND<1				

DUP - Duplicate sample
REP - Quality control sample (second analysis of same water sample)
ND - non detect at the limit of 1 ug/L

Table 8. Water Quality Data for Direct-Push Downgradient Transect Locations (February/March 2006)

Sampling			Water Quality Data ^a		
Location*	pН	EC (mS)	Temperature (°C)	DO (mg/L)	ORP (mV)
GP 1-3					
GP 1-6					
GP 1-9	6.2	1.20	14.7	0.5	-63
GP 1-13					
GP 1-14		-			
GP 1-15	7.0	0.83	13.3	<1.5	-134
GP 1-19					
GP 1-23					
GP 1-27	7.3	0.67	13.1	1.1	-118
GP 1-31	7.3	0.67	12.8	0.9	-177
GP 1-35	7.5	0.61	11.8	0.9	-206
GP 1-39					
GP 2-3					
GP 2-7					
GP 2-9	5.4	1.92	8.8	1.0	17
GP 2-13					
GP 2-17					
GP 2-21	6.5	0.65	13.1	0.9	-150
GP 2-25	6.6	0.64	14.1	1.0	-152
GP 2-29	6.7	0.63	15.5	0.7	-183
GP 2-33	6.8	0.60	15.7	0.6	-153
GP 2-37	7.2	0.64	12.6	0.6	-287
GP 3-3		-			
GP 3-6					
GP 3-9					
GP 3-13					
GP 3-17					
GP 3-21	6.7	0.67	10.0	0.0	-143
GP 3-25	6.7	0.73	8.2	< 0.5	-140
GP 3-29	6.8	0.73	7.5	0.0	-142
GP 3-33	6.8	0.70	7.9	0.0	-165
GP 3-37					
GP 3-40					
GP 4-3					
GP 4-6					
GP 4-9					
GP 4-13					
GP 4-15					
GP 4-17	6.6	0.54	9.0	0.1	-139
GP 4-21	6.8	0.53	8.9	0.4	-151
GP 4-25	6.9	0.55	8.4	0.5	-153
GP 4-25*	7.1	0.59	10.4	0.5	-198
GP 4-29					
GP 4-29*	7.2	0.62	7.5	0.2	-171
GP 4-29**					
GP 4-33	7.2	0.59	6.5	0.0	-167
GP 4-37					

Sampling		Water Quality Data ^a								
Location*	pН	EC (mS)	Temperature (°C)	DO (mg/L)	ORP (mV)					
GP 4-40										
GP 5-3										
GP 5-6										
GP 5-7										
GP 5-9										
GP '5-10										
GP 5-11	-									
GP 5-13	-									
GP 5-15	-									
GP '5-15										
GP 5-17	7.0	1.77	11.0	0.0	-128					
GP 5-21	7.1	0.68	11.0	0.5	-148					
GP 5-25	-									
GP 5-29										
GP 5-29	6.1	0.56	12.2	0.3	-132					
GP 5-33	6.7	0.59	10.8	0.0	-189					
GP 5-37	6.9	0.58	10.0	0.0	-186					
GP 5-40	-									
GP 6-3										
GP 6-6										
GP 6-7	-									
GP 6-9	5.5	1.29	5.7	0.4	7					
GP 6-13										
GP 6-17	6.7	0.61	10.6	0.4	-149					
GP 6-21										
GP 6-23	6.8	0.63	8.9	0.3	-138					
GP 6-25	6.9	0.64	8.4	0.3	-129					
GP 6-29	6.9	0.60	9.6	0.0	-168					
GP 6-33	6.9	0.62	8.3	0.2	-154					
GP 6-37	7.0	0.57	9.8	0.3	-135					
GP 6-40										
GP 7-4/8										
GP 7-8/12										
GP 7-12/16										
GP 7-16/20										
GP 7-20/24										

a All measurements were made with a Horiba U-22 meter.
--- No water quality data taken
EC = electrical conductivity
DO = dissolved oxygen
ORP = oxidation-reduction potential

Table 9. Field Data And Results for Constant Drawdown Aquifer Testing in Direct-push Downgradient Transect Locations (February/March 2006)

Sampling Location*	Drawdown (ΔH) (ft BSWS**)	Volume purged (ml)	Time (min)	Time (sec)	Total Time (sec)	Q (ft3/s)	Q/ΔH (ft ³ /ft/s)	K (cm/sec)	K (ft/d)
GP 1-9	1	240	3	10	190	4.5E-05	4.5E-05	2.5E-03	6.9E+00
GP 1-15	15	140	1	53	113	4.4E-05	2.9E-06	1.6E-04	4.5E-01
GP 1-19	19	100	2	50	170	2.1E-05	1.1E-06	6.0E-05	1.7E-01
GP 1-23	23	190	2	0	120	5.6E-05	2.4E-06	1.3E-04	3.8E-01
GP 1-27	27	300	1	15	75	1.4E-04	5.2E-06	2.9E-04	8.1E-01
GP 1-31	1	300	1	0	60	1.8E-04	1.8E-04	9.7E-03	2.7E+01
GP 1-35	6.6	280	1	16	76	1.3E-04	2.0E-05	1.1E-03	3.1E+00
GP 1-39	28	80	5	0	300	9.4E-06	3.4E-07	1.8E-05	5.2E-02
GP 2-3	1.5	110	2	15	135	2.9E-05	1.9E-05	1.1E-03	3.0E+00
GP 2-7	5.5	20	4	0	240	2.9E-06	5.4E-07	2.9E-05	8.3E-02
GP 2-9	7.5	300	0	56	56	1.9E-04	2.5E-05	1.4E-03	3.9E+00
GP 2-13	11.5	80	3	0	180	1.6E-05	1.4E-06	7.5E-05	2.1E-01
GP 2-17	15.5	130	3	0	180	2.6E-05	1.6E-06	9.0E-05	2.6E-01
GP 2-21	19.5	365	1	53	113	1.1E-04	5.8E-06	3.2E-04	9.1E-01
GP 2-25	23.5	330	0	40	40	2.9E-04	1.2E-05	6.8E-04	1.9E+00
GP 2-29	6	265	1	0	60	1.6E-04	2.6E-05	1.4E-03	4.0E+00
GP 2-33	9.8	320	1	30	90	1.3E-04	1.3E-05	7.0E-04	2.0E+00
GP 2-37	26.2	275	3	0	180	5.4E-05	2.1E-06	1.1E-04	3.2E-01
GP 3-6	5	140	2	0	120	4.1E-05	8.2E-06	4.5E-04	1.3E+00
GP 3-9	8	60	4	0	240	8.8E-06	1.1E-06	6.1E-05	1.7E-01
GP 3-13	12	25	2	0	120	7.4E-06	6.1E-07	3.4E-05	9.5E-02
GP 3-17	16	260	2	30	150	6.1E-05	3.8E-06	2.1E-04	6.0E-01
GP 3-21	20	300	1	0	60	1.8E-04	8.8E-06	4.9E-04	1.4E+00
GP 3-25	24	340	1	10	70	1.7E-04	7.1E-06	3.9E-04	1.1E+00
GP 3-29	23	235	1	0	60	1.4E-04	6.0E-06	3.3E-04	9.4E-01
GP 3-33	16.4	290	0	40	40	2.6E-04	1.6E-05	8.6E-04	2.4E+00
GP 3-37	25.6	45	2	0	120	1.3E-05	5.2E-07	2.8E-05	8.1E-02
GP 3-40	27.9	80	3	0	180	1.6E-05	5.6E-07	3.1E-05	8.8E-02
GP 4-3	2	55	2	40	160	1.2E-05	6.1E-06	3.3E-04	9.5E-01
GP 4-6	5	100	2	0	120	2.9E-05	5.9E-06	3.2E-04	9.2E-01
GP 4-9	8	140	2	0	120	4.1E-05	5.1E-06	2.8E-04	8.0E-01
GP 4-13	12	60	3	30	210	1.0E-05	8.4E-07	4.6E-05	1.3E-01

Sampling Location*	Drawdown (ΔH) (ft BSWS**)	Volume purged (ml)	Time (min)	Time (sec)	Total Time (sec)	Q (ft3/s)	Q/ΔH (ft³/ft/s)	K (cm/sec)	K (ft/d)
GP 4-17	16	300	1	0	60	1.8E-04	1.1E-05	6.1E-04	1.7E+00
GP 4-21	20	260	2	0	120	7.7E-05	3.8E-06	2.1E-04	6.0E-01
GP 4-25	24	190	2	0	120	5.6E-05	2.3E-06	1.3E-04	3.6E-01
GP 4-25*	23	325	2	0	120	9.6E-05	4.2E-06	2.3E-04	6.5E-01
GP 4-29	21.3	100	3	0	180	2.0E-05	9.2E-07	5.1E-05	1.4E-01
GP 4-29*	21.3	240	2	0	120	7.1E-05	3.3E-06	1.8E-04	5.2E-01
GP 4-29**	23	220	1	0	60	1.3E-04	5.6E-06	3.1E-04	8.8E-01
GP 4-33	23	260	1	0	60	1.5E-04	6.7E-06	3.7E-04	1.0E+00
GP 4-37	21.3	160	2	30	150	3.8E-05	1.8E-06	9.7E-05	2.8E-01
GP 4-40	23	60	2	0	120	1.8E-05	7.7E-07	4.2E-05	1.2E-01
GP 5-11	9.5	80	4	0	240	1.2E-05	1.2E-06	6.8E-05	1.9E-01
GP 5-13	11.5	115	3	30	210	1.9E-05	1.7E-06	9.2E-05	2.6E-01
GP 5-17	15.5	310	0	45	45	2.4E-04	1.6E-05	8.6E-04	2.4E+00
GP 5-21	19.5	180	1	0	60	1.1E-04	5.4E-06	3.0E-04	8.5E-01
GP 5-25	23.5	130	3	0	180	2.6E-05	1.1E-06	6.0E-05	1.7E-01
GP 5-29	23	70	2	0	120	2.1E-05	9.0E-07	4.9E-05	1.4E-01
GP 5-29	26.2	260	1	15	75	1.2E-04	4.7E-06	2.6E-04	7.3E-01
GP 5-33	13.1	250	1	0	60	1.5E-04	1.1E-05	6.2E-04	1.7E+00
GP 5-37	13.1	290	1	0	60	1.7E-04	1.3E-05	7.2E-04	2.0E+00
GP 5-40	19.7	50	3	0	180	9.8E-06	5.0E-07	2.7E-05	7.8E-02
GP 6-9	7.5	280	1	0	60	1.6E-04	2.2E-05	1.2E-03	3.4E+00
GP 6-13	11.5	230	2	0	120	6.8E-05	5.9E-06	3.2E-04	9.2E-01
GP 6-17	15.5	410	0	48	48	3.0E-04	1.9E-05	1.1E-03	3.0E+00
GP 6-21	19.5	140	3	0	180	2.7E-05	1.4E-06	7.7E-05	2.2E-01
GP 6-23	21.5	300	1	30	90	1.2E-04	5.5E-06	3.0E-04	8.5E-01
GP 6-25	23.5	250	0	45	45	2.0E-04	8.3E-06	4.6E-04	1.3E+00
GP 6-29	19.7	300	1	15	75	1.4E-04	7.2E-06	3.9E-04	1.1E+00
GP 6-33	19.7	270	1	15	75	1.3E-04	6.5E-06	3.5E-04	1.0E+00
GP 6-37	19	290	0	30	30	3.4E-04	1.8E-05	9.9E-04	2.8E+00
GP 6-40	27.2	100	3	0	180	2.0E-05	7.2E-07	4.0E-05	1.1E-01
GP 7-8/12	11	250	1	15	75	1.2E-04	1.1E-05	5.9E-04	1.7E+00
GP 7-12/16	3.9	200	0	15	15	4.7E-04	1.2E-04	6.6E-03	1.9E+01
GP 7-16/20	10.6	380	0	25	25	5.4E-04	5.1E-05	2.8E-03	7.9E+00
GP 7-20/24	1.3	300	0	30	30	3.5E-04	2.7E-04	1.5E-02	4.2E+01

^{*} See Figure 2
** BSWS – Below estimated static water surface

Table 10. Monitoring Well Chemical Concentration Data Comparison

Chemical (ug/L)	1,1-D0	CE		cis-1,2-l	DCE		1,1,2,2-	PCA		PCI	E	
Collection By	ASU Feb/Mar '06	Site 89	Date Site 89	ASU Feb/Mar '06	Site 89	Date Site 89	ASU Feb/Mar '06	Site 89	Date Site 89	ASU Feb/Mar '06	Site 89	Date Site 89
MW-16	110	<400	Nov '04	16000	35200	Nov '04	110	<420	Dec '05	<1	<400	Nov '04
MW-16	120	<400	Nov '04	19000	35200	Nov '04	<1	<420	Dec '05	<1	<400	Nov '04
MW-16IW	<1	<2	Nov '04	1	<2	Nov '04	<1	< 0.5	Dec '05	<1	<2	Nov '04
MW-16QC	120	<400	Nov '04	20000	35200	Nov '04	<1	<420	Dec '05	<1	< 400	Nov '04
MW-17	59	< 200	Nov '04	16000	1820	Nov '04	220	210 J	Dec '05	1	571	Nov '04
MW-17IW	25	<100	Nov '04	740	890	Nov '04	1	<130	Dec '05	82	49	Nov '04
MW-18	250	<10000	Nov '04	71000	85700	Nov '04	240000	250000	Dec '05	1800	<10000	Nov '04
MW-19	150	< 2000	Nov '04	17000	15200	Nov '04	51000	43000	Dec '05	410	< 2000	Nov '04
MW-20	NAPL	<20000	Nov '04	NAPL	55200	Nov '04	NAPL	65000	Dec '05	NAPL	<20000	Nov '04
MW-20IW	15	<2	Nov '04	510	63	Nov '04	17	11	Nov '04	10	9	Nov '04
MW-21	17	7.1	Nov '04	2900	748	Nov '04	1	12	Nov '04	<1	< 20	Nov '04
MW-21QC	18	<4	Nov '04	2900	11	Nov '04	<1	<4	Nov '04	<1	181	Nov '04
MW-21IW	23	<4	Nov '04	2000	11	Nov '04	<1	<4	Nov '04	77	181	Nov '04
MW-22	1700	< 2000	Nov '04	110000	156000	Nov '04	270	14000	Dec '05	130	1070 J	Nov '04
MW-23	440	< 4000	Nov '04	56000	121000	Nov '04	6000	39600	Nov '04	960	2580 J	Nov '04
MW-23	520	< 4000	Nov '04	59000	121000	Nov '04	6900	39600	Nov '04	1300	2580 J	Nov '04
MW-24	54	<100	Nov '04	7600	2160	Nov '04	<1	<100	Nov '04	<1	<100	Nov '04
MW-24IW	22	<2	Nov '04	3500	2	Nov '04	<1	<2	Nov '04	11	6	Nov '04
MW-25	15	6.4	Nov '04	3100	665	Nov '04	2	<20	Nov '04	<1	<20	Nov '04
MW-25IW	24	<10	Nov '04	5200	32	Nov '04	1	<10	Nov '04	110	162	Nov '04
MW-27	910	<20000	Nov '04	80000	22600	Nov '04	4200	5500	Dec '05	1200	<20000	Nov '04
MW-27IW	8	<40	Nov '04	120	137	Nov '04	<1	<40	Nov '04	270	339	Nov '04
MW-27IW DUP	7	<40	Nov '04	100	137	Nov '04	<1	<40	Nov '04	290	339	Nov '04
MW-28	300	<10000	Nov '04	52000	49100	Nov '04	340	5150	Nov '04	120	<10000	Nov '04
MW-29	130	<1000	Nov '04	21000	33100	Nov '04	<1	2300	Dec '05	110	<1000	Nov '04
MW-29IW	17	<2	Nov '04	110	2	Nov '04	1	<2	Nov '04	15	<2	Nov '04
MW-30	140	< 500	Nov '04	25000	12500	Nov '04	<1	<1000	Dec '05	2	< 500	Nov '04
MW-30 DUP	150	< 500	Nov '04	32000	12500	Nov '04	<1	<1000	Dec '05	3	< 500	Nov '04
MW-31	40	<4000	Nov '04	6400	40400	Nov '04	11000	9700	Dec '05	450	<1000	Nov '04
MW-31IW	260	<2000	Nov '04	66000	61300	Nov '04	1800	1300 J	Dec '05	2	<2000	Nov '04

N/A – No Data Available, Dup – Duplicate Sample, REP – Quality Control Sample (second analysis of same sample), ND – Non-Detect (detection limit not available)

Table 10. Monitoring Well Chemical Concentration Data Comparison (cont.)

Chemical (ug/L)	1,1,2-T	CA	Date	TCE		Date	trans-1,2-l	DCE	Date	Vinyl Chlo	ride	Date
Collection By	ASU Feb/Mar '06	Site 89	Site 89	ASU Feb/Mar '06	Site 89	Site 89	ASU Feb/Mar '06	Site 89	Site 89	ASU Feb/Mar '06	Site 89	Site 89
MW-16	<1	< 400	Nov '04	360	< 420	Dec '05	330	669	Nov '04	24000	< 200	Nov '04
MW-16	<1	< 400	Nov '04	16	<420	Dec '05	370	669	Nov '04	23000	< 200	Nov '04
MW-16IW	<1	<2	Nov '04	<1	0.13 J	Dec '05	<1	<2	Nov '04	<1	<1	Nov '04
MW-16QC	<1	< 400	Nov '04	8	< 420	Dec '05	380	669	Nov '04	23000	< 200	Nov '04
MW-17	28	455	Nov '04	2000	1000	Dec '05	3000	230	Nov '04	150	<100	Nov '04
MW-17IW	<1	<100	Nov '04	2800	3100	Dec '05	42	<100	Nov '04	21	27	Nov '04
MW-18	3600	4600	Nov '04	140000	320000	Dec '05	33000	23600	Nov '04	670	< 5000	Nov '04
MW-19	420	680	Nov '04	30000	17000	Dec '05	5800	3780	Nov '04	110	<1000	Nov '04
MW-20	NAPL	<20000	Nov '04	NAPL	390000	Dec '05	NAPL	9880 J	Nov '04	NAPL	<10000	Nov '04
MW-20IW	<1	<2	Nov '04	130	49	Nov '04	13	1 J	Nov '04	210	4	Nov '04
MW-21	<1	< 20	Nov '04	82	330	Nov '04	110	87	Nov '04	9500	16	Nov '04
MW-21QC	<1	<4	Nov '04	86	170	Nov '04	110	2	Nov '04	9300	16	Nov '04
MW-21IW	<1	<4	Nov '04	57	170	Nov '04	39	2	Nov '04	500	<2	Nov '04
MW-22	300	1000 J	Nov '04	5700	140000	Dec '05	38000	32300	Nov '04	22000	4060	Nov '04
MW-23	460	2750 J	Nov '04	72000	498000	Nov '04	28000	24000	Nov '04	4400	1580 J	Nov '04
MW-23	510	2750 J	Nov '04	75000	498000	Nov '04	30000	24000	Nov '04	5000	1580 J	Nov '04
MW-24	<1	<100	Nov '04	8	475	Nov '04	200	<100	Nov '04	15000	< 50	Nov '04
MW-24IW	<1	<2	Nov '04	400	2	Nov '04	140	<2	Nov '04	400	<1	Nov '04
MW-25	<1	< 20	Nov '04	0	30	Nov '04	88	13	Nov '04	2900	<10	Nov '04
MW-25IW	<1	<10	Nov '04	480	35	Nov '04	610	<10	Nov '04	130	<5	Nov '04
MW-27	200	<20000	Nov '04	74000	150000	Dec '05	9700	5390 J	Nov '04	13000	<10000	Nov '04
MW-27IW	<1	<40	Nov '04	180	1010	Nov '04	3	<40	Nov '04	5	39	Nov '04
MW-27IW DUP	<1	<40	Nov '04	180	1010	Nov '04	3	<40	Nov '04	4	39	Nov '04
MW-28	<1	<10000	Nov '04	8200	121000	Nov '04	3100	4160 J	Nov '04	5700	< 5000	Nov '04
MW-29	<1	<1000	Nov '04	9200	19000	Dec '05	370	738 J	Nov '04	12000	2090	Nov '04
MW-29IW	<1	<2	Nov '04	280	1	Nov '04	2	<2	Nov '04	5	<1	Nov '04
MW-30	<1	< 500	Nov '04	6600	2800	Dec '05	420	282	Nov '04	7900	4290	Nov '04
MW-30 DUP	<1	< 500	Nov '04	7600	2800	Dec '05	440	282	Nov '04	8600	4290	Nov '04
MW-31	150	<1000	Nov '04	24000	49000	Dec '05	3300	9490	Nov '04	170	< 2000	Nov '04
MW-31IW	200	1480 J	Nov '04	11000	11000	Dec '05	18000	10600	Nov '04	4000	840 J	Nov '04

N/A – No Data Available, Dup – Duplicate Sample, REP – Quality Control Sample (second analysis of same sample), ND – Non-Detect (detection limit not available)

Draft Final

Site Specific Demonstration Plan NAS Alameda – Site 5

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:

Arizona State University Battelle Memorial Institute Site 5 at the Naval Air Station (NAS), Alameda Point is located in Alameda, California. The site consists of more than 18 acres of land located in the central portion of Alameda Point (Figure 1) and includes Building 5, the largest building at Alameda Point which covers approximately 12.5 acres.

Building 5 housed specialty shops for aircraft component repair and maintenance from 1942 until the base was closed in April 1997. Building 5 also housed a plating shop and a "selective" plating shop where small parts were plated by hand. These shops were closed in 1990 and 1993. A wastewater treatment facility for industrial wastewater was located near the southwestern corner of Building 5. A hazardous water storage area at Site 5 was closed in mid-1988. This area was located outside of Building 5 in the southeastern corner of the site. Access to this area is fenced and access is restricted. Additional activities at site 5 included a lead-acid and nickel-cadmium batteries service area.

Chemical contaminants from the various industrial processes inside Building 5 are believed to have been released directly to the subsurface beneath certain operational areas. Solvents are believed to have been released as spills and as leakage from a solvent tank in the hazardous waste storage area outside the southeast corner of Building 5. Solvent releases are also believed to have occurred from a solvent tank located on the eastern side of Building 5, and solvents and metals are believed to have been released from the plating shop via floor drains.

Multiple investigations have shown plume 5-1 and 5-3 to be known dense non-aqueous phase liquid (DNAPL) plumes. Plume 5-1 is located on the eastern side of Building 5 and plume 5-3 is located within Building 5 as shown in Figure 2. Plume 5-1 investigations showed the DNAPL consisted mainly of trichloroethylene (TCE) and trichloroethane (TCA) and the degradation products from these compounds. The DNAPL plume area was determined to be about 1/3 of an acre. A pilot scale six phase heating (SPH) application was performed in plume 5-1 in June of 2002. Based on the results of the pilot, full-scale SPH applications were performed at plume 5-1 and will be performed at plume 5-3.

The conceptual subsurface model for Site 5 includes five geologic units. The Lower San Antonio Unite, or Yerba Buena Mud, is a clay that extends from a depth of approximately 125 feet (ft) below ground surface (bgs) to 170 to 200 ft bgs. The Upper San Antonio Unite overlies the Yerba Buena Mud and extends from 100 ft bgs to about 125 ft bgs. It consists of interbedded very fine-grained, silty sand and green-grey silty clay. The Merritt Sand Formation overlies the San Antonio Formation and extends from 35 ft bgs to about 100 ft bgs and contains 3 sediment types: 1) yellow-brown clayey sand, with approximately 5 percent clay, 2) moist, silty sand, and 3) fine-grained, well-sorted sand with some shell fragments. The Bay Sediment Unit (BSU) overlies the Merritt Sand formation and extends from 15 ft bgs to about 35 ft bgs and is composed of three sediment types: 1) a stiff, moist, dark olive clay, 2) sand and clay with a number of shell fragments, and 3) silty sand with interbedded layers of fine-grained sand. Artificial fill overlies the BSU and is composed of olive brown, unconsolidated fine to mediumgrained sand with lenses of silty sand, gravelly sand, or sandy gravel. Groundwater is encountered in the artificial fill between 4 and 7 ft bgs. The BSU separates the first (FWBZ) and second water-bearing zones (SWBZ) with low-permeability sediments. The FWBZ is located in the artificial fill and upper part of the BSU. The FWBZ general flow direction is to the

northeast. The SWBZ is situated within the lower part of the BSU, the Merritt Sand, and the Upper San Antonio Unit. The SWBZ general flow direction is to the south.

Installation for full-scale six-phase heating at began in 2004. The system consisted of 7 electrodes installed to a depth of 19 ft bgs and 28 electrodes installed to a depth of 14 ft bgs and 1 electrode installed to 15 ft bgs. The total treatment area was approximately 1/3acre (Figure 3).

In addition, 2 monitoring wells were installed inside the treatment area. These two monitoring wells were used along with 12 monitoring wells installed during the pilot scale SPH application. Table 1 shows the screened intervals of the wells along with their diameter.

The full-scale system was brought on-line in July 2004 and was operated until November 2004. The remedial system performance was continuously monitored during operation, and an estimated 3,000 pounds of volatile organic compound (VOC) contamination were removed in recovered volatile vapors and groundwater.

After shutdown, monitoring wells were monitored for four months. All monitoring wells and electrodes were left in place for possible use at a later time.

The available documentation for NAS Alameda, Site 5 suggests that it is a good site for further investigation because:

- The hydrogeology of the site is reasonably well-characterized
- The aerial extent of the source zone was reasonably defined prior to treatment
- Full treatment of a source zone was performed
- The depth to groundwater is 4 to 7 feet
- The total depth of impacted groundwater is about 30 feet
- There is access to sampling locations immediately down-gradient of the remediated source zone
- The system employed at this site represents a state-of-the-art ERH system
- Pre- and post-treatment groundwater data are available
- Direct-push technologies can be used for sampling
- The monitoring well network is still present and accessible

Consistent with the already-approved generic demonstration plan for this project, the following site-specific activities are proposed:

- (1) Verification of the site geological conceptual model before any new investigative work by:
 - a. Measurement of depths to groundwater in nearby wells (to determine depth to groundwater, flow direction, and hydraulic gradient). See Table 1 for monitoring well details and Figure 4 for measurement locations.
 - b. Collection of one continuous soil core at the down-gradient edge of the treated source zone (to qualitatively confirm the site geology and to identify depths for subsequent groundwater vertical profile sampling). One or two additional cores will be collected if time permits. See Figure 4 for sampling location.

- c. Slug tests conducted in existing groundwater monitoring wells in the area to get estimates of hydraulic conductivity over the screened intervals for those wells (to help identify if any zones are more conductive than others). See Table 1 for details on the monitoring wells and Figure 4 for measurement location.
- (2) Collection of data necessary to determine groundwater concentrations and fluxes leaving the treated source zone:
 - a. Groundwater samples collected from existing groundwater monitoring wells with available historical data. See Table 1 for details on the monitoring wells and Figure 4 for their locations.
 - b. Groundwater samples will be collected using direct-push tools along a transect perpendicular to the direction of groundwater flow at the down-gradient edge of the original source zone. See Figure 4 for groundwater sampling locations. Sampling locations will be approximately 40 feet apart, and at each location samples will be collected, as possible, at least every 4 feet down to a maximum depth of 30 ft (and at least once in each distinct lithologic change suggested by the soil core). The samples will be analyzed via a headspace analysis on a gas chromatograph (GC) equipped with dry electrolytic conductivity detector (DELCD), photo-ionization detector (PID), and flame-ionization (FID) detectors. If time permits, samples will be collected at additional locations as well. The specific depths and numbers of samples collected at each location may be adjusted depending on the analytical results in the field.
 - c. Aquifer specific-capacity tests will be conducted at each depth where a groundwater sample is collected. These tests will be conducted using the direct-push groundwater sampler and will involve the measurement of the steady flow rate achieved with a fixed drawdown; ideally, all tests will be conducted with the same fixed drawdown (usually 0.3 1.0 feet).

Health and Safety Plan (HASP) NAS Alameda – Site 5

SECTION 1: GENERAL INFORMATION AND DISCLAIMER		
CLIENT NAME: Environmental Security Technology Certification Pr	ogram (ESTCP) PROJEC	T NAME: ESTCP Thermal Evaluation
PRINCIPAL INVESTIGATORS: Bruce Alleman (Battelle) and Paul J	ohnson (Arizona State University	ity)
PROJECT LEADER: Sam Yoon		
PREPARED BY: Sam Yoon	DATE:	04/12/2006
NOTE: This Site Specific Health and Safety Plan - employees for work at this site. Battelle is is written for the specific LEVEL D site con specified. If these conditions change, a new named in Section 17. Subcontractors shall be solely responsible for the health and laws and regulations. In accordance with 1910.120(b)(1)(iv emergency response procedures, and any potential fire, expl Specific Safety and Health Plan and site information obtain contractors and subcontractors are responsible for: (1) devel Hazard Communication Program and any other written haza and regulations; (2) providing their own personal protective employees have been health and safety trained in accordanc (4) providing evidence of medical surveillance and medical site safety officer (SSO) responsible for ensuring that their expectations.	not responsible for its unditions, purposes, task plan must be utilized a safety of their employees and so and (v), Battelle will inform so soion, health, safety or other had by others available during rejoing their own Health and Safard specific programs required be equipment (PPE); (3) providing the with applicable federal, state a approvals for their employees; employees comply with their own	shall comply with all applicable ubcontractors of the site zards by making this Site gular business hours. All ety Plan including a written by federal, state and local laws a documentation that their and local laws and regulations; and (5) designating their own
taking any other additional measures required by their site a	ctivities.	
SECTION 2: PROJECT INFORMATION		
(1) SITE INFORMATION Site ERH Pilot Test Site near BLDG 5 Name: Address IR Site 5 Former Naval Air Station Alameda Alameda Point, CA 92101	Site Project Contact: Phone Number: Site Safety & Health Contact: Phone Number	Glenna Clark 619-532-0951 Sam Yoon O: 614-424-4569/ C: 614-218-0627
(2) SITE CLASSIFICATION (check or circle all that apply)	(3) ENTRY OBJECT	TIVES (check or circle all that apply)
 √ Hazardous (RCRA/CERCLA/State) Construction Landfill (Non-Hazardous) UST/LUST Manufacturing Active √ Inactive Other: military installation 	□ Well Di □ Samplii	ng, Water
(4) BATTELLE/ASU TASKS	TASK PERFORMED	RY OTHERS
Groundwater Investigation B1. B2. Groundwater sampling B3. Water level survey and slug tests B4. Analytical activities	Direct push a collection 01. collection 02. IDW disposa 03.	ctivities for gw sample
(5) PROJECT ORGANIZATION AND COORDINATION – T		

		ICIPAL INVESTIGATOR	LS		man/Paul Johnso	on	
		SAFETY OFFICER ERNATIVE SITE SAFET	v	Sam Yoon			
		CER(S)	Y	Jennifer Tr	iplett/Paul Dahle	en	
	PUB	LIC INFORMATION OF	FICER	N/A			
		RECORD KEEPER			Jennifer Triplett		
	SITE	PERSONNEL WITH CP	R/FA	Sam Yoon			
		D TEAM LEADER(S) ER FIELD TEAM MANA	CERC	Sam Yoon			
	OTH	EK FIELD TEAM MANA	GERS				
(6)		SITE CONTROL					
						lle operations on site. A safe p /or high-visibility barrier tape.	erimeter has
	No u	nauthorized person should	be within t	this area.			
	The o	on site Command Post and	staging are	ea have been established a	t the pilot ERH	test area near Building 5 at IR	Site 5.
						termine daily wind directions. exposure should a release occu	
		rol boundaries have been e			ERH test area .	These boundaries are identified	d in the field by:
SECT	ION 3:	PHYSICAL HAZA		шрс.			
(1)	IDEN	NTIFY POTENTIAL PHY	SICAL HA			11 37	
		Confined Space		Steep/Uneven Terrain	√ 		
	√	Heavy Equipment Moving Parts	$\sqrt{}$	Heat Stress Extreme Cold			
		Heavy Lifting	V	Ionizing Radiation		=	
		Electrical		Traffic	Ц	Other.	
		Overhead Hazards		Biological Hazards			
		Fall (>6; Vertical)		Surface Water (Immersion	on)	-	
		be mitigated by:			_		
		ing site personnel as to ide			ork area.		
		ifying the "kill switch" on			1	1	
	(7) Perso (8) Antis	onal protection equipment a eptic ointment, solution, a	such as ear nd bug rep	muffs, ear plugs, winter j ellent (especially for ticks	akets, etc. will be) will be included	e don to site personnel. d in the first aid kit for insect st	ings.
(2)		ETY EQUIPMENT REQU					
		Explosimeter		Eye Wash		Confined Space Warning Sign	1S
		Fall Protection		Emergency Shower	\checkmark	Communications – On Site	
	1	Equipment	1	E 4: **	1	G : .: 0.000:	
	V	Barrier Tape	$\sqrt{}$	Emergency Air Horn	V	Communications – Off Site	
	$\sqrt{}$	Traffic Cones		Lights		Other:	
		Stretcher		Lights – emergency			
	$\sqrt{}$	First Aid Kit		Ladder	_		
		A-B-C- Fire	$\sqrt{}$	Tick Repellant			
		Extinguisher Snake Bite Kit		Flotation Device (USCG	Туре		
				III)			
		pment will be located in the cellular telephones, walk				communication procedures. Th	e field crew will
SECT	ION 4:	CHEMICAL HAZA	RDS INFO	ORMATION			
(1)	IDEN	TIFIED CONTAMINAN	TS				
(1)				(attached historical inform	nation physical s	lecarintian man of contaminati	on
			c material	(anacheu mstoricai miorn	iation, physical C	lescription, map of contaminati	OII
	Med Med	ated date, if available).	ices Involv	ad Chara	eteristics	Estimated	PEL
	IVIEC	aia Substal	ices mivolv	cu Cilara	actiones	Concentrations	1 60
	GW	Chlorinated (1,1-dichlo		oons VO and TO		Total chlorinated VOCs up to 35,000	

	1,1-dichloroethene, 1,1,1-trichloroethane)		μg/L prior to the ERH operation, recent monitoring was at 700 μg/L.
SL	Chlorinated hydrocarbons	VO and TO	NA NA
	GW (ground water), SW (surfa	ace water), WW (wastewater), AIR (a	air), SL (soil), SD
Media types	(sediments), WL (waste gas) OT (other).	e, liquid), WS (waste, solid), WD (wa	aste, sludge), WG (waste,
Characterizations		osive, caustic), IG (ignitable), RA (ra fectious), UN (unknown), OT (other,	describe)
,	oxicological properties of the site contamination		
DESCRIBE I	POTENTIAL FOR CONTACT WITH	I EACH MEDIA TYPE FOR EACH	OF THE BATTELLE/ASU TASKS
STED IN SEC 2.4:	F	DOTENTIAL FOR	
BATTELL TASK #	ROUTE OF EXPOSUR	RE POTENTIAL FOR CONTACT	METHOD OF CONTROL
B1	Inhal/Ingest/Contact/Abso		Level D PPE
B2	Inhal/Ingest/Contact/Abso		Level D PPE
B3	Inhal/Ingest/Contact/Abso		Level D PPE
B4	Inhal/Ingest/Contact/Abso		Level D PPE
	brief the field team on interpretation o		
	to chemical hazards.	The attached MSDSs and particular	ly on symptoms and signs of
	AZARD COMMUNICATION PROG	RAM	
	are introduced to the site by Battelle (e		vatives, etc.), bring a copy of the
	ardous Communication Program and a		
	personnel. The current list of chemica		
1,1,1-Trichlo	roethane (TCA)	1,2-dichloroethene (c	cis- and trans-), Vinyl
		chloride	
1,1,2-Trichlor	roethane (TCA)	Trichloroethene, Tetr	rachloroethene
	ethane, 1,2-dichloroethane (DCA)	Methanol	
1.1-dichloroe	thene (DCE)	Alcohol, Liquinox®.	HCL (preservative)
1,1-dichloroe	thene (DCE)	Alcohol, Liquinox®,	HCL (preservative)
CTION 6: E	NVIRONMENTAL MONITORING		
CTION 6: EI The followin EQUIPMEN	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING	nts shall be used on site at the specific	
CTION 6: EI The followin EQUIPMEN Combustible Gas	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s	nts shall be used on site at the specific	ed intervals for breathing zone monitoring
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific PERIOD nuous/other	ed intervals for breathing zone monitoring
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific PERIOD nuous/other	ed intervals for breathing zone monitoring
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific PERIOD nuous/other nuous/other	ed intervals for breathing zone monitoring
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV)	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin 10.6_ daily/hourly/contin	nts shall be used on site at the specific period pe	ed intervals for breathing zone monitoring
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific period pe	ed intervals for breathing zone monitoring
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific in PERIOD in the property of the pro	ed intervals for breathing zone monitoring
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma)	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific in PERIOD nuous/other nuous/other nuous/other nuous/other nuous/other nuous/other	ed intervals for breathing zone monitoring
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific repersion of PERIOD nuous/other	ed intervals for breathing zone monitoring
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific is PERIOD nuous/other	ed intervals for breathing zone monitoring ACTION LEVEL
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific in PERIOD nuous/other	ed intervals for breathing zone monitoring ACTION LEVEL
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin daily/hourly/contin	nts shall be used on site at the specific in PERIOD nuous/other	ed intervals for breathing zone monitoring ACTION LEVEL
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific in PERIOD nuous/other	ed intervals for breathing zone monitoring ACTION LEVEL
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific in PERIOD nuous/other in nuous/other	ed intervals for breathing zone monitoring ACTION LEVEL
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific in PERIOD nuous/other	aily prior to and after each day gbook.
CTION 6: EI The followin EQUIPMER Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook.
CTION 6: EI The followin EQUIPMER Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook.
CTION 6: EI The followin EQUIPMER Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook.
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco Action Level potential for	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook.
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco Action Level potential for (> 10 min).	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook. ation should be given to the ducts. Levels are for persistence
CTION 6: EXAMPLE COMPUSED COMP	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin equipment is to be calibrated according ord calibration data and air concentration s for work shutdown and excavation. release of highly toxic compounds from	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook. ation should be given to the flucts. Levels are for persistence ACTION LEVEL
CTION 6: EXAMPLE COMPUSED COMP	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook. ation should be given to the ducts. Levels are for persistence ACTION LEVEL ACTION LEVEL >Background
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco Action Level potential for (> 10 min). Uncharacterize	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook. ation should be given to the ducts. Levels are for persistence ACTION LEVEL >Background >50% PEL, REL, TLV
CTION 6: EXAMPLE COMPUTED COMP	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin requipment is to be calibrated according ord calibration data and air concentration s for work shutdown and excavation. release of highly toxic compounds from the daily for the dai	nts shall be used on site at the specific at PERIOD nuous/other n	aily prior to and after each day gbook. ation should be given to the ducts. Levels are for persistence ACTION LEVEL >Background >50% PEL, REL,
The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco Action Level potential for (> 10 min). Uncharacterize Characterized	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin equipment is to be calibrated according ord calibration data and air concentration s for work shutdown and excavation. release of highly toxic compounds from each Airborne Vapors or Gases d Airborne Gases, Vapor, Particulates	nts shall be used on site at the specific at PERIOD nuous/other nu	aily prior to and after each day gbook. ation should be given to the flucts. Levels are for persistence ACTION LEVEL >Background >50% PEL, REL, TLV <19.5; >23.5 > 10% LEL
CTION 6: EI The followin EQUIPMEN Combustible Gas Indicator O ₂ Meter PID (Lamp eV) FID Radiation Meter (Gamma) Respirable Dust GC/ECD/FID GC/FID/PID/DE Monitoring e of use. Reco Action Level potential for (> 10 min). Uncharacterized Oxygen Flammability Military and/	NVIRONMENTAL MONITORING g environmental monitoring instrumer NT MONITORING s daily/hourly/contin requipment is to be calibrated according ord calibration data and air concentration s for work shutdown and excavation. release of highly toxic compounds from the daily for the dai	nts shall be used on site at the specific in PERIOD nuous/other n	aily prior to and after each day gbook. ation should be given to the ducts. Levels are for persistence ACTION LEVEL >Background >50% PEL, REL, TLV < 19.5; >23.5 > 10% LEL g activities will be notified via a

personnel in charge or their designated representative will be notified immediately. Hourly perimeter monitoring (support zone) will be conducted to assess whether organic vapors or odors are leaving the work area. SECTION 7: HEALTH AND SAFETY TRAINING/MEDICAL MONITORING PROGRAM The project staff is included in the Battelle Health and Safety Training and Medical Monitoring Programs in conformance with 29 CFR 1910.R. HAZWOPER TRAINING MEDICAL INITIAL REFRESHER CPR/FA/ (Hrs/Date) (Date) (Date) (Dates) Sam Yoon March 2006 40 hours/Jan June 17, 2005 8/25/2005; 16. 1997 6/27/2003 (good for 3 years) Shane Walton 10/27/2005; Nov 2004 40 hours/April January 13, 2006 1994 5/28/2004 (good for 3 years) Jennifer Triplett 40 hours/June August 7, 2005 2001 Paul Dahlen 40 hours/Nov February 2006 1992 SECTION 8: PERSONAL MONITORING No personal exposure monitoring or heat/cold stress monitoring will take place on site. If the need for such monitoring is anticipated, this HASP will be modified as accordingly. SECTION 9: CONFINED SPACE ENTRY No confined space and/or trench entries will take place on site. If the possibility of such entries taking place exists, this HASP will be modified accordingly. SECTION 10: COMMUNICATION PROCEDURES The following standard hand signals will be used in case of failure to radio communications in each contaminant Hand gripping throat Can't Talk, Having difficulty breathing Grip partner's wrist and both hands around wrist Can't Talk, Leave area immediately Hands on top of head Need assistance Thumbs up OK, I am all right, I understand Thumbs down No, negative If applicable, telephone communications to the Command Post Should be Established as soon as possible. The stationary and/or mobile phone number(s) will be available one week prior to the start of field work. The HASP will be amended when these numbers are available. The command post telephone is The mobile phone is SECTION 11: DECONTAMINATION PROCEDURES Personnel and equipment leaving an exclusion zone shall be thoroughly decontaminated at the decontamination facility constructed at the command post. The SSO is responsible for monitoring adherence with this decontamination plan. A Modified Level D decontamination protocol shall be used with the following decontamination stations: Equipment Drop (IF NECESSARY) (8) Boot Covers, and Glove Wash and Rinse (IF NECESSARY) (9)Outer Boot and Glove Removal (IF NECESSARY) Outer Garment Removal (IF NECESSARY) (10)(11)Inner Glove Removal (IF NECESSARY) Field Hand Wash (12)The following decontamination equipment is required (check or circle all that apply) Decon Pad (Plastic Sheet) Dry Brushes Detergent Soap Trash Cans/Bags Wet Brushes Other Decontamination Solution Buckets Water SECTION 12: EMERGENCY PROCEDURES On site personnel will use the following standard emergency procedures. The SSO shall be notified of any on site emergencies and be responsible for ensuring that the procedures are followed. DESIGNATED EMERGENCY Air Horn Personal Injury in the SIGNAL: **Exclusion Zone** Upon notification of an injury in the Exclusion Zone, the designated emergency signal shall be sounded. All site personnel shall assemble at the decontamination line. The SSO or alternate should evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the Support Zone. The on site CPR/FA personnel shall initiate the appropriate first aid, and contact should be made for an ambulance (and other emergency services as needed) and

ER-0314 67 *Appendix D*

with the designated medical facility (if required). No persons shall reenter the Exclusion Zone until the cause of the injury or

symptoms is determined. Fire/Explosion	DESIGNATED EMERGENCY Air Horn
Upon notification of a fire or explosion assembled at the decontamination line.	SIGNAL: on site, the designated emergency signal shall be sounded and all site personnel The fire department shall be alerted and all personnel moved to a safe distance from the
involved area. <u>Equipment Failure</u>	
	oring) on site fails to operate properly, the Field Team Leader and SSO shall be notified ilure on continuing operations on site. If the failure affects the safety of personnel or
prevents completion of the Work Plan	tasks, all personnel shall leave the Exclusion Zone until the situation is evaluated and
appropriate actions taken.	
Emergency escape routes are designate the decontamination line	d for use in those situations where egress from the Exclusion Zone cannot occur through
In all situations, when an on site emerge (4) The conditions resulting in the en	ncy results in evacuation of the Exclusion Zone, personnel shall not reenter until:
(5) The hazards have been reassesse	d by the SSO.
(6) The Site Safety Plan has been red SECTION 13: SPILL CONTROL P	riewed by the SSO and Corporate Health and Safety Manager. ROCEDURES
	d or solids exist on site, and no spill control plan is necessary. If the possibility of such e, this HASP will be modified accordingly.
SECTION 14: EMERGENCY INFO	
(1) LOCAL RESOURCES	
Ambulance (name):	Alameda Hospital Phone: 911
Hospital (name):	Alameda Hospital Phone: 911 or (510) 522-3700
Police (local or state): Fire (name):	Alameda City Police Phone: 911 or (510) 522-2423 Alameda Fire Department Phone: 911 or (510) 337-2100
HAZ MAT Responder:	National Response Center, Phone: 911
•	Toxic Chemicals and Oil
On-Site CPR/FA(s):	Spills Phone: 614-218-0627
. ,	Juni 1 001 1 101C. 014 210 0027
* For life-threatening emergencies or	emergency trauma care. 10 miles from the furthest work area and the ambulance response time is approximately 15 minute :
	10 miles from the futurest work area and the amountaine response time is approximately
** For non-life threatening medical car. The above hospital is approximately	e. 30 minutes from the furthest work area. Injured workers will be transported here for non-emergen.
treatment only.	30 minutes from the furthest work area. Injured workers will be transported here for non-emergen
DIRECTIONS TO NEAREST HOS	PITAL – SEE ATTACHED MAP:
(2) Figure 1.	
(3) BATTELLE RESOURCES	
Manager, Corporate Health and Safe	ty (ETE Division) Site Contact: Sam Yoon: 614-424-4569
Gary Carlin, 614-424-4929	
-	
Dattalla Sagurity Office	
Battelle Security Office (614) 424-4444	
, ,	
	CTIVE EQUIPMENT (check or circle all that apply)
	protection is required on this site. If the possibility of the need for respiratory protection SP will be modified accordingly.
CLOTHING	GLOVES BOOTS OTHER
☐ Coveralls ☐ Tyvek	□ Cotton □ Safety
☐ Saranex	$\sqrt{\text{Nitrile}}$ \square Neoprene \square Goggles
□ PE Tyvek	☐ Butyl √ Steel Toe ☐ Face Shield
□ Other:	□ Neoprene□ Viton√ Hearing Protection
	□ Viton □ PVC
	□ PVA
	√ Latex
SECTION 16: SAFE WORK PRAC	TICES

	THE FOLLOWING PRACT	ICES MUST BE FOLLOWED BY PERSONNEL ON S	SITE								
12.	Smoking, eating, chewing	gum or tobacco, or drinking are forbidden except in clea	an or designated areas.								
13.	Ignition of flammable liqu	ids within or through improvised heating devices (e.g., b	barrels) is forbidden.								
14.		avated materials, or other contaminated materials must be	pe minimized.								
15.	Use of contact lenses is pro										
16.	Do not kneel on the ground										
17.		If drilling equipment is involved, know where the kill switch is.									
18.	All electrical equipment us interrupter (GFCI) protected	sed in outside locations, wet areas, or near water must be ed outlets.	e plugged into ground fault circuit								
19.	A "Buddy System" in which	ch another worker is close enough to render immediate a	aid will be in effect.								
20.	Good housekeeping practic	ces are to be maintained.									
21.		ay be exposed to corrosive materials, water suitable for	quick drenching or flushing shall be								
	available for immediate us										
22.		weather-related working conditions (i.e., thunderstorm,									
		suspended until conditions improve or appropriate prote	ection from the elements is provided.								
~		KNOWLEDGMENTS									
	LAN REVIEWED BY:		DATE								
	&S Manager:	Linc Remmert									
	incipal Investigator	Bruce Alleman; Paul Johnson									
	oject Leader:	Sam Yoon									
Si	te Safety Officer:	Sam Yoon									
		d the information in this HASP form and the attached M	ISDSs. I understand the site hazards								
		apply with the contents of the plan.									
	FIELD PERSONNEL (Print	SIGNATURE	DATE								
	Name)										
		<u> </u>									
		<u> </u>									
•	VISITOR (Print Name)	SIGNATURE	DATE								
	` ,										
											
	Organization/Agency										
	~ -0										
	Organization/Agency	<u> </u>									
	Organization/Agency										

ER-0314 69 Appendix D

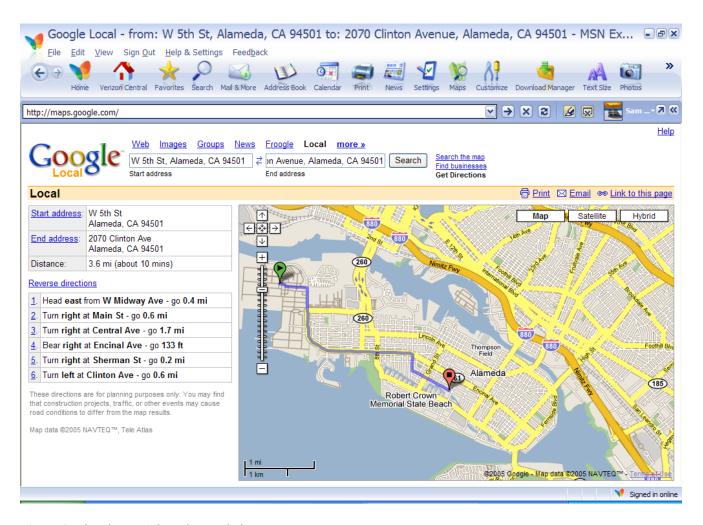


Figure 1. Directions to Alameda Hospital

Draft Final

Data Analysis Report NAS Alameda – Site 5

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:
Arizona State University
Battelle Memorial Institute

August 2006

The vendors and products, including the equipment, system components, and other materials identified in this report, are primarily for information purposes only. Although some of these vendors and products may have been used in the past, mention in this report does not consti-
tute a recommendation for using these vendors or products.

Contents

Figures	
Tables	
Acronyms and Abbreviations	
1. Introduction	
2. Field Investigation	
3. References	
Figures	
FIGURE 1. SITE MAP	
FIGURE 2. DIRECT-PUSH LOCATIONS	
FIGURE 3. HYDRAULIC CONDUCTIVITY MEASUREMENT LOCATIONS	
FIGURE 4. MONITORING WELL DEPTH-TO-WATER MEASUREMENTS AND GROUNDWATER	
SAMPLING LOCATIONS	
FIGURE 5. CROSS-SECTION OF DIRECT PUSH SAMPLING LOCATIONS	
FIGURE 6. VINYL CHLORIDE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μG/L)	
Figure 7. 1,1-Dichloroethene Direct-Push Groundwater Concentrations (μg/L)	,
FIGURE 8. TRANS-1,2-DICHLOROETHENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μG/L	(ر
Figure 9. 1,1-Dichloroethane Direct-Push Groundwater Concentrations (μg/L)	
FIGURE 10. CIS-1,2-DICHLOROETHENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μg/L)	
FIGURE 11. 1,2-DICHLOROETHANE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μg/L)	
FIGURE 12. 1,1,2-TRICHLOROETHANE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (µG/L)	
FIGURE 13. TRICHLOROETHYLENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μG/L) FIGURE 14. HYDRAULIC CONDUCTIVITY TEST DATA (CM/S) OVERLAIN ON TRICHLOROETHYLENE	
FIGURE 14. HYDRAULIC CONDUCTIVITY TEST DATA (CM/S) OVERLAIN ON TRICHLOROETHYLENE	

FIGURE 15. MASS FLUX TOOLKIT INPUTS

CONTOUR PLOT

Tables

- TABLE 1. GEOLOGIC DESCRIPTIONS OF CONTINUOUS SOIL CORES (JUNE 2006)
- TABLE 2. SAMPLING LOCATIONS AND TYPES OF TEST PERFORMED (JUNE 2006)
- TABLE 3. SLUG TEST RESULTS (JUNE 2006)
- Table 4. Depth-to-Groundwater and Groundwater Elevations for Monitoring Wells (June 2006)

- TABLE 5. WATER QUALITY DATA FOR MONITORING WELLS (JUNE 2006)
- Table 6. Chemical Concentration Data for Monitoring Wells (June 2006)
- Table 7. Chemical Concentration Data for Direct-Push Downgradient Transect Locations (June 2006)
- TABLE 8. FIELD DATA AND RESULTS FOR CONSTANT DRAWDOWN AQUIFER TESTING IN DIRECT-PUSH DOWNGRADIENT TRANSECT LOCATIONS (JUNE 2006)
- TABLE 9. MONITORING WELL CHEMICAL CONCENTRATION DATA COMPARISON

Acronyms and Abbreviations

bgs below ground surface

cis-1,2-DCE cis-1,2-dichloroethene

DELCD dry electrolytic conductivity detector

DO dissolved oxygen

EC electrical conductivity
ERH electrical resistance heating

ESTCP Environmental Security Technology Certification Program

FID flame-ionization detector

ft feet

GC gas chromatography

kg kilogram

NAPL non-aqueous phase liquid

ORP oxidation reduction potential

PID photo-ionization detector

temp temperature TCE trichloroethylene

VOA volatile organic analysis

yr year

1. Introduction

The post treatment field investigation of NAS Alameda under the Environmental Security Technology Certification Program (ESTCP) project CU-0314, *Critical Evaluation of State of the In-Situ Thermal Treatment Technologies*, was performed June 1 through June 9, 2006. Figure 1 identifies the extent of the previous electrical resistance heating (ERH) remediation area, which was also the specific area of interest for this particular field investigation.

Consistent with the objectives set forth under the CU-0314 Demonstration Plan, the field investigation at this site included the following:

- Verification of the site hydrogeological conceptual model
- Groundwater sampling of monitoring wells
- Depth-discrete analysis of hydraulic conductivity and dissolved petroleum hydrocarbons at temporary sampling locations downgradient of the treatment zone.

2. Field Investigation

In accordance with the approved generic demonstration plan for this project, the following sitespecific activities were conducted:

- 1) Verification of the site hydrogeological conceptual model:
 - a. For confirmation of geology, two continuous soil cores was collected at direct-push sampling locations GP10 and GP11 shown in Figure 2. The continuous soil cores/direct-push sampling locations were located at the down-gradient edge of the treatment zone. Table 1 presents qualitative geologic descriptions from visual observations of the continuous soil core.
 - b. Hydraulic conductivity slug testing was conducted in 11 monitoring wells as identified in Table 2 and in Figure 3. The slug test data were analyzed using both the Hvorslev and the Bouwer and Rice Methods; results are presented in Table 3. The Hvorslev' expression for determining hydraulic conductivity from slug test data is:

$$K = (r^2 ln(L_e/R))/(2L_e t_{37})$$
 Where
$$K = \text{hydraulic conductivity (L/T)}$$

$$r = \text{radius of well casing (L) (0.083 \text{ ft})}$$

$$R = \text{radius of well screen (L) (0.50 \text{ ft})}$$

$$L_e = \text{length of well screen (L) (5 \text{ or } 10 \text{ ft})}$$

$$t_{37} = \text{time for water level to rise or fall } 37\% \text{ of the initial change (T)}$$
 (from data set)
$$(\text{Fetter, } 2000).$$

The Bouwer and Rice expression for determining hydraulic conductivity from slug test data is:

$$K=(r_c^2 \ln(R_e/R) / (2L_e)) * ((1/t) \ln(H_o/H_t))$$

Where K = hydraulic conductivity (L/T)

r_c = radius of well casing (L) (0.083 ft) R = radius of gravel envelope (L) (0.50 ft)

 R_e = effective radial distance over which head is dissipated (L)

(from data set)

 L_e = length of well screen (L) (5 or 10 ft)

 $H_0 = drawdown at t=0 (L) (from data set)$

 $H_t = drawdown at t=t (L) (from data set)$

 $t = time since H = H_o (T) (from data set)$

(Fetter, 2000).

- c. Depth-to-groundwater was measured in the 15 groundwater monitoring wells identified in Table 2 and in Figure 4. Depth-to-water measurements and groundwater elevations are summarized in Table 4.
- 2) Collection of water quality samples from 11 groundwater monitoring wells within the treatment zone for analysis of dissolved chlorinated hydrocarbon groundwater concentrations:
 - a. Table 2 identifies the groundwater monitoring wells from which samples were collected. Prior to sample collection, three well-volumes were purged. Groundwater was then collected for analysis of field parameters and stored in volatile organic analysis (VOA) vials for analysis of dissolved chlorinated hydrocarbon concentrations. General water quality field parameters including pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP) were measured using an Horiba U-22 meter. Petroleum hydrocarbon analysis was performed on-site by heated-headspace analysis and gas chromatography (GC) using a dry electrolytic conductivity detector (DELCD), photo-ionization detector (PID) and a flame-ionization detector (FID). General water quality data for permanent groundwater monitoring well installations can be found in Table 5 and chemical concentration data can be found in Table 6. All non-detect samples are listed as less than the detection limit.
- 3) Depth-discrete hydraulic conductivity and dissolved chlorinated hydrocarbon concentration data were collected on three foot intervals as possible from 6.5 ft below ground surface (bgs) to 21 ft bgs at all seven direct-push sampling locations.

a. Groundwater quality data were collected from depth-specific intervals at all direct-push sampling locations (See Table 2 and Figure 2). Sampling locations were spaced on approximately 15 ft centers, as possible, along a transect downgradient of the source zone and perpendicular to the direction of groundwater flow. Figure 2 presents the direct-push sampling locations. Using percussion assisted direct-push technology and a modified Geoprobe Groundwater Profiler, groundwater samples were collected using a peristaltic pump on 3-ft intervals from 6.5 ft bgs to 21 ft bgs. The location of the depth-discrete groundwater samples are shown in Figure 5. Dissolved chlorinated hydrocarbon concentration analysis was conducted, as described above, and the results are summarized in Table 7.

Aquifer specific-capacity tests were conducted at depth-specific intervals at direct push sampling locations GP1 through GP6 and GP8 as indicated in Table 2. Specific-capacity tests involve the measurement of the flow rate achieved under fixed drawdown and are analyzed using the Theim Equation to estimate hydraulic conductivity. The field data and results for aquifer testing are shown in Table 9. The Theim equation for hydraulic conductivity is:

```
T = (Q/(2(h_2-h_1))* \ln(r_2/r_1) Where T = \text{transmissivity } (L^2/T) Q = \text{pumping rate } (L^3/T) h_1 = \text{head at distance } r_1 \text{ from the pumping well } (L) h_2 = \text{head at distance } r_2 \text{ from the pumping well } (L) and K = T/b Where K = \text{hydraulic conductivity } (L/T) b = \text{length of sampler or screen section } (L) \text{ (0.5 ft or length of screen)} (Fetter, 2000).
```

The monitoring well chemical concentration data collected in June 2006 by the ASU/Battelle team were compared to the previous monitoring well chemical concentration data available for the site (March 2005). The analytical results for each are shown in Table 10.

Figures 6 to 13 present contour plots of the chemical concentrations for eight of the ten chemicals measured at the depth-discrete direct push sampling locations. Two of chemicals, 1,1,2-Trichloroethane (TCA) and tetrachloroethene (PCE), were not contoured because all groundwater samples were non-detect (less than detection limit of 1 ug/L). Figure 14 presents the specific capacity pump test results for each discrete-depth direct push sampling interval overlaid on the trichloroethylene (TCE) concentration plot.

A TCE mass flux calculation was performed using the Mass Flux Toolkit, Version 1.0. The gradient was calculated using Devlin (2003) and the three wells with the greatest lateral separation with ASU depth to water measurements and grade elevations from previous work at NAS Alameda (grade elevations were not available for all monitoring wells). This program is a freeware program developed by Groundwater Services, Inc. and others under a contract funded by the Environmental Security Technology Certification Program (ESTCP). Figure 15 is a snapshot of the input screen with TCE being used to perform the mass flux analysis. A linear spatial and vertical interpolation of the data was used for the mass flux analysis. The TCE mass flux was estimated to be 2.56E-02 kg/yr.

3. References

Fetter, C.W. 2000. Applied Hydrogeology. 4th ed. Upper Saddle River, New Jersey: Prentice-Hall. pp.197-200.

Devlin, J.F. 2003. "A Spreadsheet Method of Estimating Best-fit Hydraulic Gradients Using Head Data from Multiple Wells." Groundwater, 41(3): 316-320.

Figures

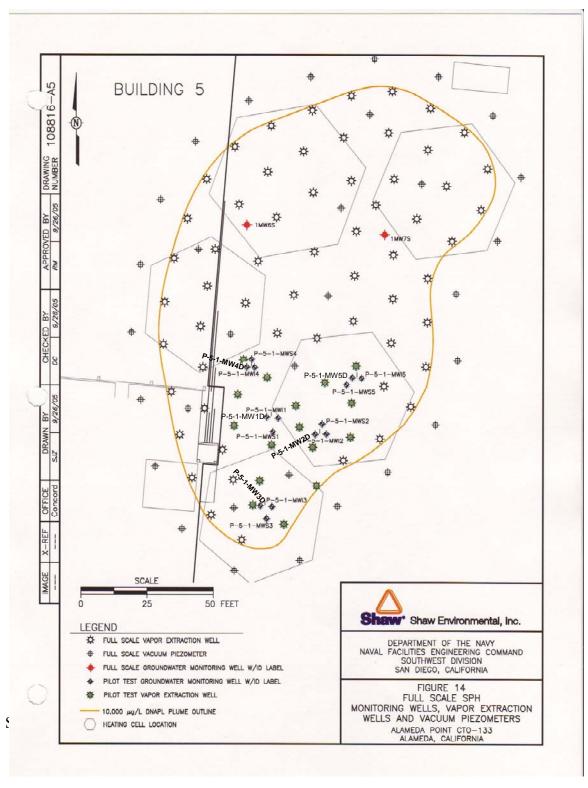


Figure 1. Site Map

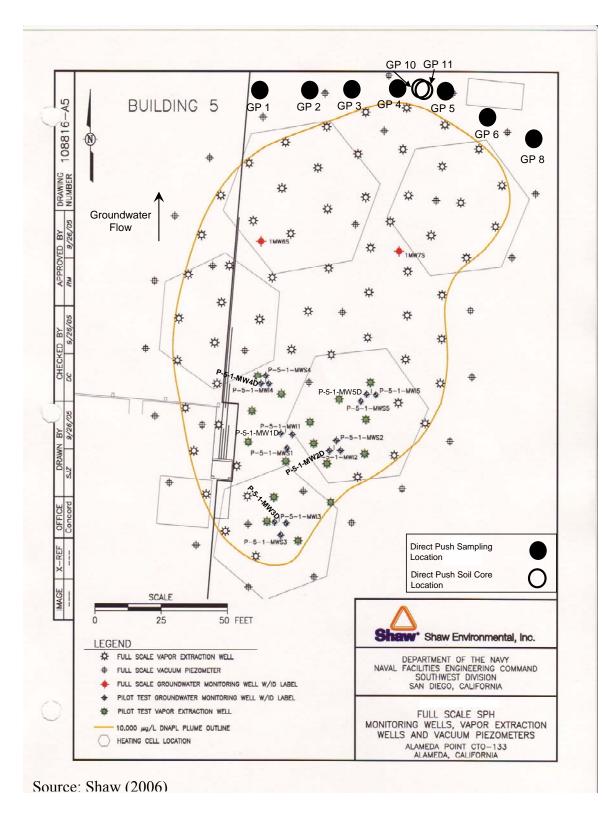


Figure 2. Direct-Push Locations

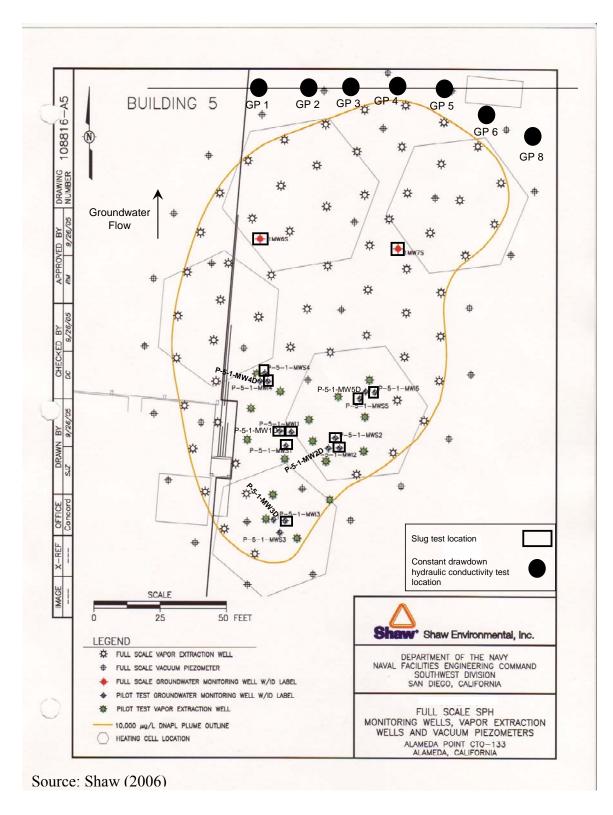


Figure 3. Hydraulic Conductivity Measurement Locations

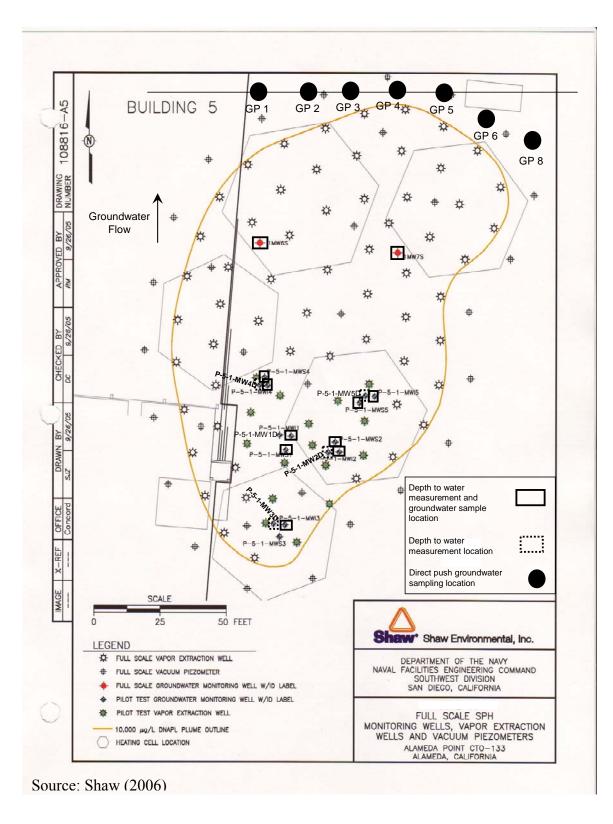


Figure 4. Monitoring Well Depth-to-Water Measurement and Groundwater Sampling Locations

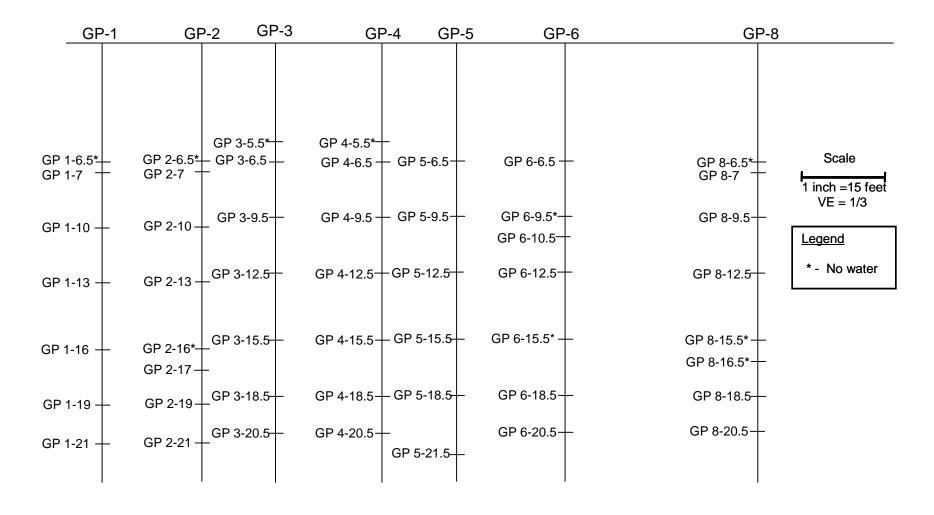


Figure 5. Cross-section of Direct Push Sampling Locations

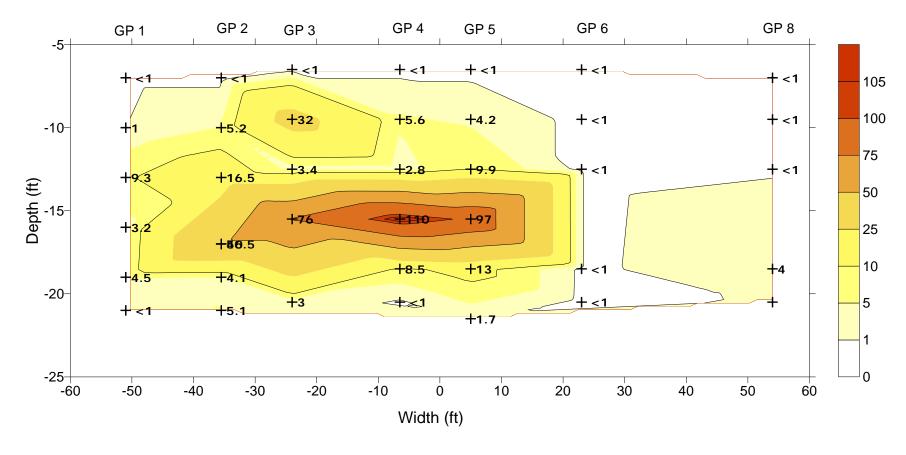


Figure 6. Vinyl Chloride Direct-Push Groundwater Concentrations (µg/L)

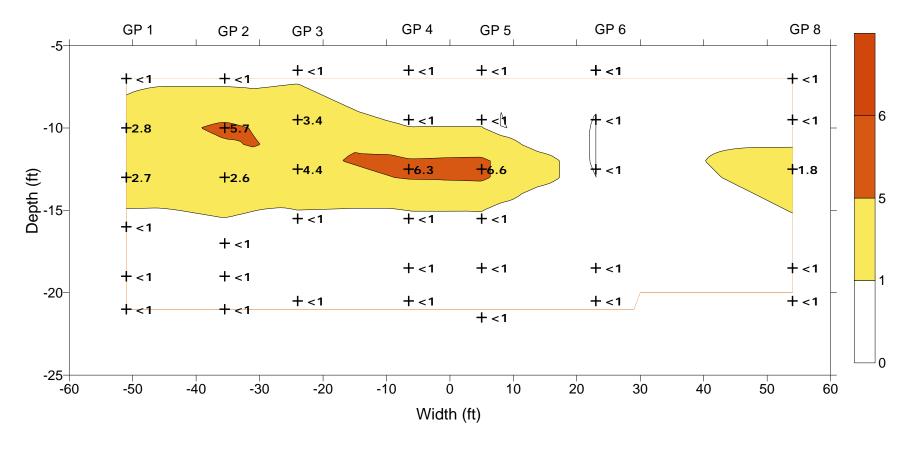


Figure 7. 1,1-Dichloroethene Direct-Push Groundwater Concentrations (µg/L)

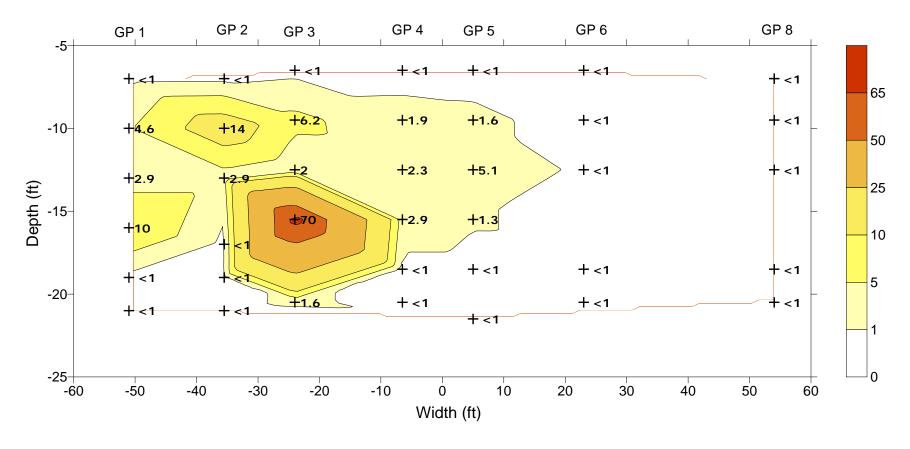


Figure 8. trans-1,2-Dichloroethene Direct-Push Groundwater Concentrations (µg/L)

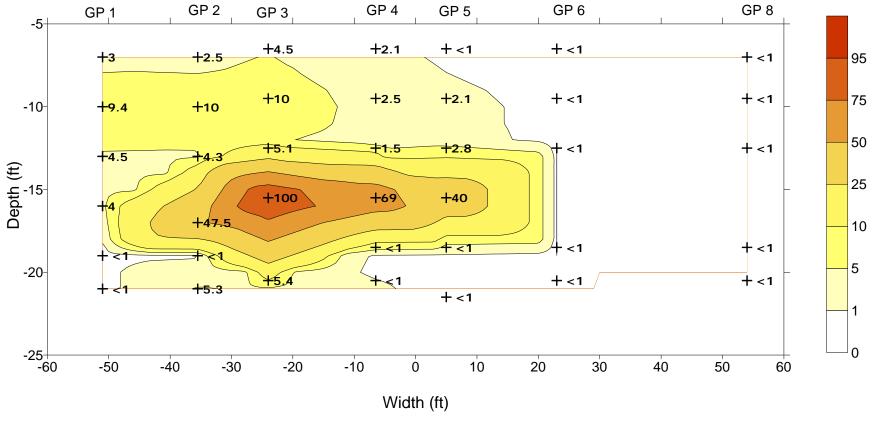


Figure 9. 1,1-Dichloroethane Direct-Push Groundwater Concentrations (µg/L)

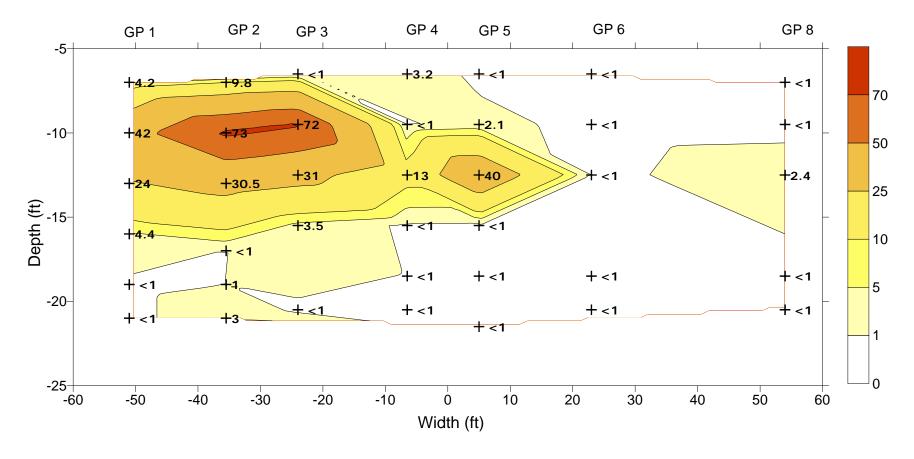


Figure 10. cis-1,2-Dichloroethene Direct-Push Groundwater Concentrations (µg/L)

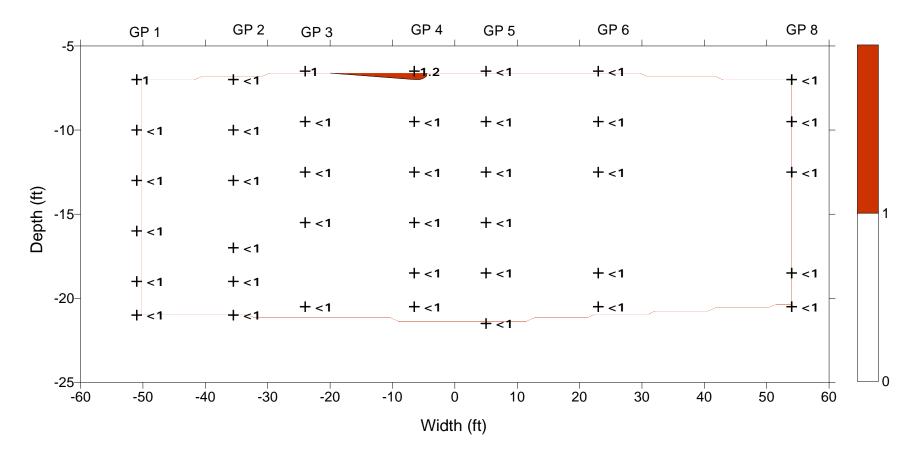


Figure 11. 1,2-Dichloroethane Direct-Push Groundwater Concentrations (µg/L)

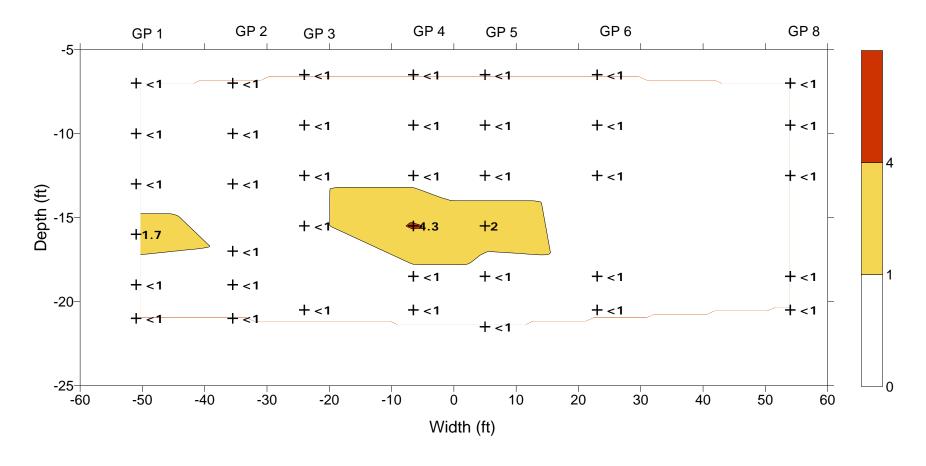


Figure 12. 1,1,2-Trichloroethane Direct-Push Groundwater Concentrations (µg/L)

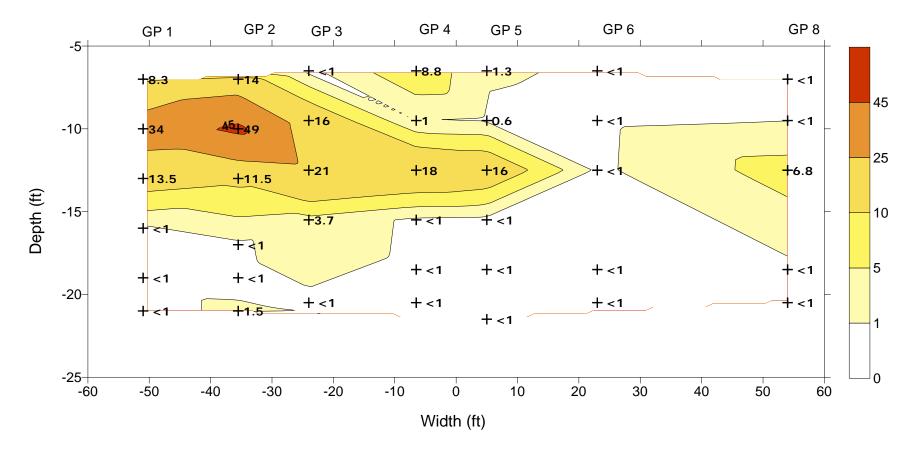


Figure 13. Trichloroethylene Direct-Push Groundwater Concentrations (µg/L)

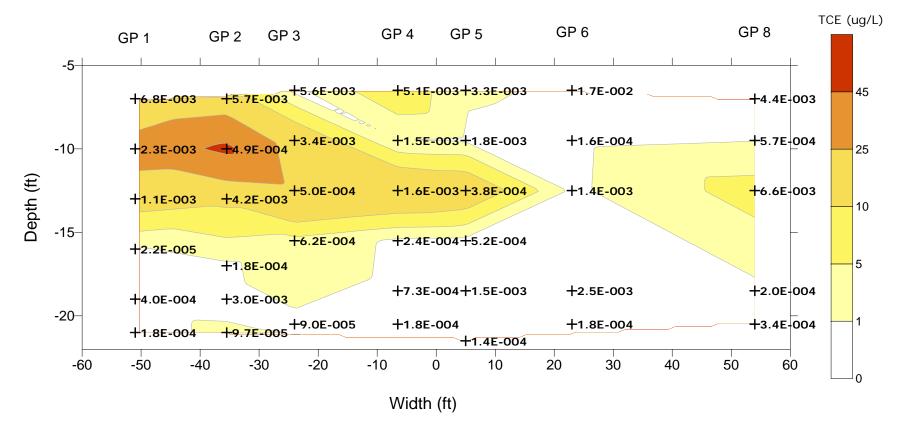


Figure 14. Hydraulic Conductivity Test Data (cm/s) Overlain on Trichloroethylene Contour Plot

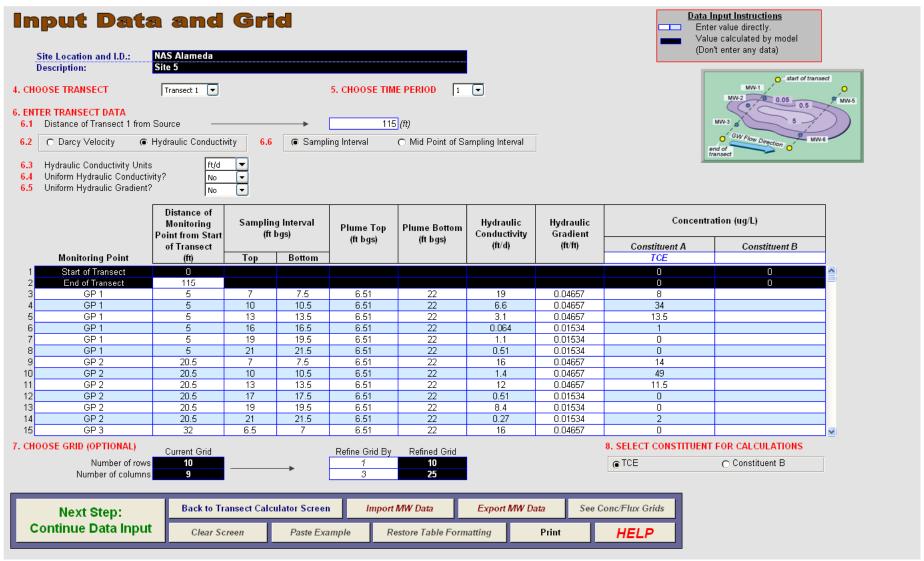


Figure 15. Mass Flux Toolkit Inputs

Tables

Table 1. Geologic Descriptions of Continuous Soil Cores (June 2006)

Boring Depth (ft)	Subsurface Features							
	Continuous Soil Core GP 10							
0-1	Sands and gravels							
1-2	Sands							
2-3	Fine sands							
3-4	Fine sands							
4-5	Gravelly sands with some silt							
5-6	Medium to course sand with some gravel							
6-7	Fine sands							
7-8	Fine sands							
8-9	Fine sands							
9-10	Silty fine sands							
10-11	Fine sands							
11-12	Fine sands							
12-13	Fine sands							
13-14	Fine sands							
14-15	Fine sands with some silt							
15-16	Silty clay							
16-17	Silty clay							
17-18	Silty clay							
18-19	Transition from silty clay to fine sands							
19-20	Fine sands							
20-21	Silty fine sands with some clay							
21-22	Clay							

Table 2. Sampling Locations and Types of Test Performed (June 2006)

Groundwater	Ph	ysical Assessn	Water Quality Assessment		
Monitoring Well or Direct- push Sampling Location	Depth-To- Water Measurement	Slug Testing	Constant Drawdown Aquifer Testing	Field Parameters ^b	Dissolved Chlorinated Solvent Analysis
MW1S	Yes	Yes		Yes	Yes
MW1I	Yes	Yes		Yes	Yes
MW2S	Yes	Yes		Yes	Yes
MW2I	Yes			Yes	Yes
MW2D	Yes				
MW3I	Yes			Yes	Yes
MW3D	Yes				
MW4S	Yes	Yes		Yes	Yes
MW4I	Yes	Yes		Yes	Yes
MW4D	Yes				
MW5S	Yes	Yes		Yes	Yes
MW5I	Yes	Yes		Yes	Yes
MW5D	Yes				
MW6S	Yes	Yes		Yes	Yes
MW7S	Yes	Yes		Yes	Yes
GP1 ^a			Yes		Yes
GP2 ^a			Yes		Yes
GP3 ^a			Yes		Yes
GP4 ^a			Yes		Yes
GP5 ^a			Yes		Yes
GP6 ^a			Yes		Yes
GP8 ^a			Yes		Yes

Water quality assessments and constant drawdown tests at direct-push locations were performed on 3-ft intervals from the phreatic surface (~6' bgs) to 21-22' bgs.

Field parameters include: pH, electrical conductivity, temperature, dissolved oxygen, and oxidation reduction potential.

Table 3. Slug Test Results (June 2006)

Monitoring Well	Well Screen (ft)	Hvorslev K (cm/s)	Hvorslev K (ft/d)	Bouwer and Rice K (cm/s)	Bouwer and Rice K (ft/d)
MW1S	9-14	4.43E-03	12.56	8.27E-04	2.35
MW1I	18-21	6.20E-04	1.76	6.12E-04	1.73
MW2S	9.5-14.5	4.43E-03	12.56	2.19E-03	6.21
MW2I	18.5-21.5	6.20E-04	1.76	4.12E-04	1.17
MW3I	19-22	1.59E-04	0.45	1.46E-04	0.41
MW4S	10-15	3.25E-03	9.21	1.53E-03	4.35
MW4I	19-22	4.51E-04	1.28	2.67E-04	0.76
MW5S	9.5-14.5	4.43E-03	12.56	1.27E-03	3.59
MW5I	18.5-21.5	5.36E-04	1.52	2.34E-04	0.66
MW6S	9.5-14.5	4.64E-03	13.16	1.69E-03	4.78
MW7S	9-14	8.12E-03	23.03	1.06E-03	3.01

Table 4. Depth-to-Groundwater and Groundwater Elevations for Monitoring Wells (June 2006)

Monitoring Well	Grade* (m)	Grade* (ft)	DTW (m BTOC)	DTW (ft BTOC)	DTW (m BGS)	DTW (ft BGS)	Groundwater Elevation* (m)	Groundwater Elevation* (ft)
MW1S	3.32	10.90	1.55	5.09	1.80	5.91	1.52	4.99
MW1I	3.32	10.88	1.61	5.28	1.86	6.11	1.45	4.77
MW2S	3.16	10.38	1.49	4.88	1.73	5.66	1.44	4.72
MW2I	3.24	10.63	1.58	5.20	1.84	6.02	1.41	4.61
MW2D	3.16	10.37	1.63	5.34	1.89	6.18	1.28	4.19
MW3I	3.08	10.10	1.63	5.35	1.89	6.19	1.19	3.91
MW3D	2.96	9.70	1.69	5.55	1.98	6.51	0.97	3.19
MW4S	2.94	9.64	1.67	5.47	1.91	6.28	1.02	3.36
MW4I	2.93	9.60	1.72	5.65	1.98	6.48	0.95	3.12
MW4D	3.24	10.63	1.69	5.53	2.02	6.61	1.23	4.02
MW5S	2.80	9.17	1.52	4.98	1.77	5.82	1.02	3.35
MW5I	2.86	9.37	1.64	5.38	1.88	6.17	0.98	3.20
MW5D	2.91	9.55	1.62	5.31	1.91	6.26	1.00	3.29
MW6S	3.08	10.09**	1.83	6.00	1.99	6.51	1.09	3.58
MW7S	2.92	9.58***	1.71	5.60	1.85	6.07	1.07	3.51

DTW - Depth-to-water BTOC - Below top of casing BGS - Below ground surface

Table 5. Water Quality Data for Monitoring Wells (June 2006)

Monitoring Well	Water Quality Data ^a						
Womtoring wen	рН	EC (mS) Temperature (°C)		DO (mg/L)	ORP (mV)		
MW1S	8.9	0.10	21.20	0.2	-138		
MW1I	7.2	11.80	24.50	0.2	-198		
MW2S	8.2	0.10	20.90	0.4	-94		
MW2I	8.3	7.73	22.40	0.4	-136		
MW3I	7.8	43.00	23.60	0.5	-117		
MW4S	7.9	0.10	23.60	0.6	-90		
MW4I	6.5	33.70	26.70	0.3	-148		
MW5S	9.14	0.163	20.8	0.36	-122		
MW5I	7.9	18.70	23.30	0.5	-113		
MW6S	6.6	1.08	26.90	0.5	-145		
MW7S	6.6	0.61	24.60	0.4	-66		

a All measurements were made with a Horiba U-22 meter.

EC = electrical conductivity

DO = dissolved oxygen

ORP = oxidation-reduction potential

Table 6. Chemical Concentration Data for Monitoring Wells (June 2006)

Monitoring Well	Concentration (ug/L)										
Withintoring Wen	VC	1,1-DCE	trans-1,2-DCE	1,1-DCA	cis-1,2-DCE	1,2-DCA	1,1,1-TCA	TCE	1,1,2-TCA	PCE	
MW1S	ND <1	ND <1	ND <1	ND <1	71	ND <1	ND <1	1	ND <1	ND <1	
MW1I	ND <1	ND <1	ND <1	ND <1	2	ND <1	ND <1	2	ND <1	ND <1	
MW1I DUP	ND <1	ND <1	ND <1	ND <1	2	ND <1	ND <1	2	ND <1	ND <1	
MW2S	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1	
MW2I	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1	
MW2I REP	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1	
MW3I	1	ND <1	ND <1	ND <1	11	ND <1	ND <1	2	ND <1	ND <1	
MW3I DUP	1	ND <1	ND <1	ND <1	11	ND <1	ND <1	2	ND <1	ND <1	
MW4S	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1	4	ND <1	ND <1	
MW4I	15	ND <1	ND <1	ND <1	3	ND <1	ND <1	2	ND <1	ND <1	
MW5S	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1	
MW5I	1	1	ND <1	1	6	ND <1	ND <1	3	ND <1	ND <1	
MW6S	29	2	2	2	29	ND <1	ND <1	76	ND <1	47	
MW6S DUP	29	2	1	1	28	ND <1	ND <1	78	ND <1	46	
MW7S	1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	3	ND <1	1	

DUP - Duplicate sample

REP - Quality control sample (second analysis of same water sample)

VC - Vinyl chloride

DCE - Dichloroethene

DCA - Dichloroethane

TCA - Trichloroethane

TCE - Trichloroethene

PCE - Tetrachloroethene

ND – non detect at the limit of 1 ug/L

Table 7. Chemical Concentration Data for Direct-Push Downgradient Transect Locations (June 2006)

Sampling		Concentration (ug/L)													
Location*	VC	1,1-DCE	trans-1,2-DCE	1,1-DCA	cis-1,2-DCE	1,2-DCA	1,1,1-TCA	TCE	1,1,2-TCA	PCE					
GP 1-7	ND <1	ND <1	ND <1	3	4	1	ND <1	8	ND <1	ND <1					
GP 1-10	1	3	5	9	42	ND <1	ND <1	34	ND <1	ND <1					
GP 1-13	9	3	3	4	23	ND <1	ND <1	13	ND <1	ND <1					
GP 1-13 REP	9	3	3	5	25	ND <1	ND <1	14	ND <1	ND <1					
GP 1-16	3	ND <1	10	4	4	ND <1	2	1	ND <1	ND <1					
GP 1-19	5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1					
GP 1-19 DUP	4	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1					
GP 1-21	1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1					
GP 2-7	ND <1	ND <1	ND <1	3	10	1	ND <1	14	ND <1	ND <1					
GP 2-10	5	6	14	10	73	ND <1	ND <1	49	ND <1	1					
GP 2-13	17	3	3	4	31	ND <1	ND <1	12	ND <1	ND <1					
GP 2-13 REP	16	3	3	4	30	ND <1	ND <1	11	ND <1	ND <1					
GP 2-17	43	ND <1	ND <1	47	1	ND <1	1	ND <1	ND <1	ND <1					
GP 2-17	50	ND <1	ND <1	48	1	ND <1	1	ND <1	ND <1	ND <1					
GP 2-19	4	ND <1	ND <1	1	1	ND <1	ND <1	ND <1	ND <1	ND <1					
GP 2-19 DUP	4	ND <1	ND <1	1	1	ND <1	ND <1	ND <1	ND <1	ND <1					
GP 2-21	5	ND <1	ND <1	5	3	ND <1	ND <1	2	ND <1	ND <1					
GP 3-6.5	ND <1	ND <1	ND <1	5	1	1	ND <1	ND <1	ND <1	ND <1					
GP 3-9.5	32	3	6	10	72	ND <1	ND <1	16	ND <1	ND <1					
GP 3-12.5	3	4	2	5	31	ND <1	ND <1	21	ND <1	ND <1					
GP 3-15.5	76	ND <1	70	100	4	ND <1	ND <1	4	ND <1	ND <1					
GP 3-20.5	3	ND <1	2	5	1	ND <1	ND <1	ND <1	ND <1	ND <1					
GP 4-6.5	ND <1	ND <1	ND <1	2	3	1	ND <1	9	ND <1	ND <1					
GP 4-9.5	6	ND <1	2	3	1	ND <1	ND <1	1	ND <1	ND <1					
GP 4-12.5	3	6	2	2	13	ND <1	ND <1	18	ND <1	ND <1					
GP 4-15.5	100	ND <1	3	68	1	ND <1	4	ND <1	ND <1	ND <1					
GP 4-15.5 REP	120	ND <1	3	70	1	ND <1	4	ND <1	ND <1	ND <1					
GP 4-18.5	9	ND <1	ND <1	1	1	ND <1	ND <1	ND <1	ND <1	ND <1					

Table 7. Chemical Concentration Data for Direct-Push Downgradient Transect Locations (Continued)

Sampling										
Location*	VC	1,1-DCE	trans-1,2-DCE	1,1-DCA	cis-1,2-DCE	1,2-DCA	1,1,1-TCA	TCE	1,1,2-TCA	PCE
GP 4-20.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 5-6.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1
GP 5-9.5	4	ND <1	2	2	2	ND <1	ND <1	1	ND <1	ND <1
GP 5-12.5	10	7	5	3	40	ND <1	ND <1	16	ND <1	ND <1
GP 5-15.5	97	ND <1	1	40	ND <1	ND <1	2	ND <1	ND <1	ND <1
GP 5-18.5	14	ND <1	ND <1	1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 5-18.5 REP	12	ND <1	ND <1	1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 5-21.5	2	ND <1	ND <1	1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 6-6.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1
GP 6-6.5 DUP	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1
GP 6-10.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 6-12.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 6-18.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 6-18.5 REP	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 6-20.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 8-7	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1
GP 8-9.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1
GP 8-12.5	1	2	1	1	2	ND <1	ND <1	7	ND <1	ND <1
GP 8-18.5	4	ND <1	ND <1	1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1
GP 8-20.5	1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1

DUP - Duplicate sample

REP - Quality control sample (second analysis of same water sample)

VC - Vinyl chloride

DCE - Dichloroethene

DCA - Dichloroethane

TCA - Trichloroethane

TCE - Trichloroethene

PCE - Tetrachloroethene

 $ND-non\ detect$ at the limit of 1 ug/L

Table 8. Field Data And Results for Constant Drawdown Aquifer Testing in Direct-push **Downgradient Transect Locations (June 2006)**

Sampling Location*	Drawdown (ΔH) (ft BSWS**)	Volume purged (ml)	Time (min)	Time (sec)	Total Time (sec)	Q (ft3/s)	$Q/\Delta H (ft^3/ft/s)$	K (cm/sec)	K (ft/d)
GP 1-7	0.25	105	2	0	120	3.1E-05	1.2E-04	6.8E-03	1.9E+01
GP 1-10	2	215	1	30	90	8.4E-05	4.2E-05	2.3E-03	6.6E+00
GP 1-13	3	150	1	30	90	5.9E-05	2.0E-05	1.1E-03	3.1E+00
GP 1-16	3	10	5	0	300	1.2E-06	3.9E-07	2.2E-05	6.1E-02
GP 1-19	3	75	2	0	120	2.2E-05	7.4E-06	4.0E-04	1.1E+00
GP 1-21	3	50	3	0	180	9.8E-06	3.3E-06	1.8E-04	5.1E-01
GP 2-7	0.75	200	1	30	90	7.8E-05	1.0E-04	5.7E-03	1.6E+01
GP 2-10	1	45	3	0	180	8.8E-06	8.8E-06	4.9E-04	1.4E+00
GP 2-13	3	195	0	30	30	2.3E-04	7.7E-05	4.2E-03	1.2E+01
GP 2-17	3	50	3	0	180	9.8E-06	3.3E-06	1.8E-04	5.1E-01
GP 2-19	3	275	1	0	60	1.6E-04	5.4E-05	3.0E-03	8.4E+00
GP 2-21	3	45	5	0	300	5.3E-06	1.8E-06	9.7E-05	2.7E-01
GP 3-6.5	0.33	115	2	0	120	3.4E-05	1.0E-04	5.6E-03	1.6E+01
GP 3-9.5	2	210	1	0	60	1.2E-04	6.2E-05	3.4E-03	9.6E+00
GP 3-12.5	3	140	3	0	180	2.7E-05	9.2E-06	5.0E-04	1.4E+00
GP 3-15.5	3	115	2	0	120	3.4E-05	1.1E-05	6.2E-04	1.8E+00
GP 3-20.5	3	25	3	0	180	4.9E-06	1.6E-06	9.0E-05	2.5E-01
GP 4-6.5	0.33	105	2	0	120	3.1E-05	9.4E-05	5.1E-03	1.5E+01
GP 4-9.5	2	140	1	30	90	5.5E-05	2.7E-05	1.5E-03	4.3E+00
GP 4-12.5	3	220	1	30	90	8.6E-05	2.9E-05	1.6E-03	4.5E+00
GP 4-15.5	10	150	2	0	120	4.4E-05	4.4E-06	2.4E-04	6.9E-01
GP 4-18.5	3	135	2	0	120	4.0E-05	1.3E-05	7.3E-04	2.1E+00
GP 4-20.5	3	50	3	0	180	9.8E-06	3.3E-06	1.8E-04	5.1E-01
GP 5-6.5	0.33	100	3	0	180	2.0E-05	5.9E-05	3.3E-03	9.3E+00
GP 5-9.5	2	170	1	30	90	6.7E-05	3.3E-05	1.8E-03	5.2E+00
GP 5-12.5	3	105	3	0	180	2.1E-05	6.9E-06	3.8E-04	1.1E+00
GP 5-15.5	3	145	3	0	180	2.8E-05	9.5E-06	5.2E-04	1.5E+00
GP 5-18.5	3	215	1	30	90	8.4E-05	2.8E-05	1.5E-03	4.4E+00
GP 5-21.5	3	65	5	0	300	7.7E-06	2.6E-06	1.4E-04	4.0E-01
GP 6-6.5	0.33	170	1	0	60	1.0E-04	3.0E-04	1.7E-02	4.7E+01
GP 6-10.5	0.67	10	3	0	180	2.0E-06	2.9E-06	1.6E-04	4.6E-01
GP 6-12.5	3	195	1	30	90	7.7E-05	2.6E-05	1.4E-03	4.0E+00
GP 6-18.5	3	230	1	0	60	1.4E-04	4.5E-05	2.5E-03	7.0E+00
GP 6-20.5	2	55	5	0	300	6.5E-06	3.2E-06	1.8E-04	5.0E-01
GP 8-7	0.583	120	1	30	90	4.7E-05	8.1E-05	4.4E-03	1.3E+01
GP 8-9.5	2	70	2	0	120	2.1E-05	1.0E-05	5.7E-04	1.6E+00
GP 8-12.5	3	305	0	30	30	3.6E-04	1.2E-04	6.6E-03	1.9E+01
GP 8-18.5	3.25	60	3	0	180	1.2E-05	3.6E-06	2.0E-04	5.6E-01
GP 8-20.5	3	95	3	0	180	1.9E-05	6.2E-06	3.4E-04	9.7E-01

ER-0314 105

^{*} See Figure 2
** BSWS – Below estimated static water surface

Table 9. Monitoring Well Chemical Concentration Data Comparison

	Vinyl (Chloride	1,1	-DCE	trans-1	,2-DCE	1,1-	DCA	cis-1,	2-DCE
Sample Locations	ASU	NAS Alameda								
Sample Educations	June '06	Mar '05								
	ug/L	ug/L								
MW7S	1	3.8	ND <1	2.5	ND <1	1.5	ND <1	1.7	ND <1	4
MW6S	29	ND <5	2	22	2	16	2	4.3J	29	110
MW6S DUP	29	ND <5	2	22	1	16	1	4.3J	28	110
MW4S	ND <1	NP	1	NP						
MW4I	15	ND <1	ND <1	ND <2	ND <1	ND <2	ND <1	ND <2	3	4.6
MW1S	ND <1	ND < 0.5	ND <1	ND <1	ND <1	ND <1	ND <1	ND <1	71	ND <1
MW1I	ND <1	ND < 0.5	ND <1	ND <1	ND <1	0.3J	ND <1	ND <1	2	7.7
MW1I DUP	ND <1	ND < 0.5	ND <1	ND <1	ND <1	0.3J	ND <1	ND <1	2	7.7
MW2S	ND <1	ND < 0.5	ND <1	ND <1						
MW2I	ND <1	ND <5	ND <1	ND <10						
MW2I REP	ND <1	ND <5	ND <1	ND <10						
MW5S	ND <1	ND < 0.5	ND <1	ND <1						
MW5I	1	ND <1	1	ND <2	ND <1	ND <2	1	0.61J	6	2.9
MW3I	1	ND <1	ND <1	ND <2	ND <1	ND <2	ND <1	ND <2	11	49
MW3I DUP	1	ND <1	ND <1	ND <2	ND <1	ND <2		ND <2	11	49

Dup – Duplicate Sample, REP – Quality Control Sample (second analysis of same sample), ND – Non-Detect (detection limit not available);

DCE - Dichloroethene; DCA - Dichloroethane; TCA - Trichloroethane; TCE - Trichloroethylene; PCE - Tetrachloroethene

	1,2-I	OCA	1,1,1	-TCA	TO	CE	1,1,2	-TCA	P	CE
Sample Locations	ASU	NAS Alameda								
zumpre zoeurons	June '06	Mar '05								
	ug/L	ug/L								
MW7S	ND <1	ND < 0.5	ND <1	ND <1	3	4.7	ND <1	ND <1	1	ND <1
MW6S	ND <1	ND <5	ND <1	ND <10	76	1,200	ND <1	ND <10	47	62
MW6S DUP	ND <1	ND <5	ND <1	ND <10	78	1,200	ND <1	ND <10	46	62
MW4S	ND <1	NP	ND <1	NP	4	NP	ND <1	NP	ND <1	NP
MW4I	ND <1	ND <1	ND <1	ND <2	2	ND <2	ND <1	ND <2	ND <1	ND <2
MW1S	ND <1	ND < 0.5	ND <1	ND <1	1	ND <1	ND <1	ND <1	ND <1	ND <1
MW1I	ND <1	ND < 0.5	ND <1	ND <1	2	0.4J	ND <1	ND <1	ND <1	ND <1
MW1I DUP	ND <1	ND < 0.5	ND <1	ND <1	2	0.4J	ND <1	ND <1	ND <1	ND <1
MW2S	ND <1	ND <1	ND <1	ND <1	1	ND <1	ND <1	ND <1	ND <1	ND <1
MW2I	ND <1	ND <5	ND <1	ND <10	1	ND <10	ND <1	ND <10	ND <1	ND <10
MW2I REP	ND <1	ND <5	ND <1	ND <10	1	ND <10	ND <1	ND <10	ND <1	ND <10
MW5S	ND <1	ND < 0.5	ND <1	ND <1	1	ND <1	ND <1	ND <1	ND <1	ND <1
MW5I	ND <1	ND <1	ND <1	ND <2	3	ND <2	ND <1	ND <2	ND <1	ND <2
MW3I	ND <1	ND <1	ND <1	ND <2	2	ND <2	ND <1	ND <2	ND <1	ND <2
MW3I DUP	ND <1	ND <1	ND <1	ND <2	2	ND <2	ND <1	ND <2	ND <1	ND <2

Dup – Duplicate Sample, REP – Quality Control Sample (second analysis of same sample), ND – Non-Detect (detection limit not available);

DCE - Dichloroethene; DCA - Dichloroethane; TCA - Trichloroethane; TCE - Trichloroethylene; PCE - Tetrachloroethene

Draft

Site Specific Work Plan Air Force Plant 4 – Building 181

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by: Arizona State University Battelle

1.0 Introduction

Air Force Plant 4 (AFP 4) is located in Tarrant County, Texas, seven miles northwest of the City of Fort Worth. The plant is bounded by Lake Worth on the north, Naval Air Station Fort Worth (NASFW), formerly Carswell AFB to the east, the community of White Settlement on the south and west, and the City of Fort Worth on the west. The facility occupies 602 acres. The Air Force, based out of Wright Patterson AFB Ohio, is the owner of the facility, built in 1941 as part of the World War II needs for aircraft production. The mile long structure currently is operated by Lockheed Martin Aeronautics Company, where the F-16 is in production, parts of the F-22 are built, and the future home of the Joint Strike Fighter (and various other programs). Past management of waste oil, solvents, and fuels generated during the manufacturing operations have resulted in multiple separate sites of investigation, including landfills, fire training areas, underground storage tanks, and other areas.

The Air Force Installation Restoration Program (IRP) efforts began in 1983 with the Preliminary Assessment/Site Investigation. AFP 4 was placed on the National Priorities List in August of 1990. In 1995, the Final Remedial Investigation was approved and in 1996 the Record of Decision (ROD) was signed by the Environmental Protection Agency (EPA) Region VI and the Texas Natural Resources Conservation Commission (TNRCC).

The primary contaminant at AFP 4 in Building 181 is trichloroethylene (TCE) and is associated with the EPL groundwater plume. TCE source is believed to be degreaser tanks in Building 181 which have since been removed. In May 1991, a TCE vapor degreaser tank (T-534) was discovered to be leaking and an estimated 20,000 gallons of TCE was released.

Several subsequent investigations found that releases of TCE had migrated through cracks in the concrete building floor resulting in contamination in the unsaturated zone, including Terrace Alluvium and overlying fill dirt under Building 181. The contaminated unsaturated zone beneath Building 181 was though to be a source of contamination to Terrace Alluvial groundwater. A pilot scale six phase heating (SPH) application was performed completed in the winter of 2001. Based on the results of the pilot, a full-scale SPH application was performed in Building 181 in 2002.

The conceptual subsurface model for AFP4 includes two geologic units. Tertiary age Terrace Alluvium is exposed at ground surface, or lies beneath fill material that is generally comprised of the same Terrace Alluvium. Beneath the Terrace Alluvium lie weathered and competent bedrock consisting of Cretaceous age Goodland Limestone Formation and Walnut Clay Formation, undifferentiated at the site. Drilling logs from Building 181 record the presence of weathered limestone layers at 15 to 20 ft below ground surface (bgs) in the western portion of the site, and at 30 to 35 ft bgs in the east portion of the site. In the SPH coverage area, an approximately 5-ft thick fill layer underlies the building floor and competent bedrock is at 30 to 35 ft bgs.

The SPH application targeted an interval which included the Terrace Alluvium and weathered bedrock to a depth of approximately 35 ft bgs. The depth to groundwater is approximately 25 ft bgs during the SPH application with an east-northeast hydraulic gradient of 0.008 ft/ft with a corresponding hydraulic conductivity between 13 and 132 ft/day.

2.0 System Description

Installation for the full-scale SPH system began in 2002. The system consisted of 73 electrodes installed to a depth of 32 ft bgs, including 7 electrodes from the pilot-scale test and 2 electrodes installed during operation to enhance heat generation in target areas. The total treatment area was approximately 22,000 square feet (Figure 1).

Additionally, a monitoring network of 12 wells was used during the treatment, including five pre-existing wells and 7 newly installed monitoring wells. Table 1 shows the screened intervals of the wells along with their diameter.

The full-scale system was brought on-line in May 2002 and was operated until December 2002. The remedial system performance was continuously monitored during operation, and an estimated 1,417 pounds of TCE was removed via steam and vapor extraction systems.

The available documentation for AFP4 suggests that it is a good site for further investigation because:

- The hydrogeology of the site is reasonably well-characterized
- The aerial extent of the source zone was reasonably defined prior to treatment
- Full treatment of a source zone was performed
- The total depth of impacted groundwater is about 30 feet
- There is access to sampling locations immediately down-gradient of the remediated source zone
- The system employed at this site represents a state-of-the-art ERH system
- Pre- and post-treatment groundwater data are available
- Direct-push technologies can be used for sampling
- The monitoring well network is still present and accessible

3.0 Current Investigations

Consistent with the already-approved generic demonstration plan for this project, the following site-specific activities are proposed:

- (3) Verification of the site geological conceptual model before any new investigative work by:
 - a. Measurement of depths to groundwater in nearby wells (to determine depth to groundwater, flow direction, and hydraulic gradient). See Table 1 for monitoring well details and Figure 1 for measurement locations.
 - b. Collection of one continuous soil core at the down-gradient edge of the treated source zone (to qualitatively confirm the site geology and to identify depths for subsequent groundwater vertical profile sampling). One or two additional cores will be collected if time permits. See Figure 1 for sampling location.
 - c. Slug tests conducted in existing groundwater monitoring wells in the area to get estimates of hydraulic conductivity over the screened intervals for those wells (to help identify if any zones are more conductive than others). See Table 1 for details on the monitoring wells and Figure 1 for measurement location.

- (4) Collection of data necessary to determine groundwater concentrations and fluxes leaving the treated source zone:
 - a. Groundwater samples collected from existing groundwater monitoring wells with available historical data. See Table 1 for details on the monitoring wells and Figure 1 for their locations. These locations may be adjusted with new information on monitoring well conditions and locations.
 - b. Groundwater samples will be collected using direct-push tools along a transect perpendicular to the direction of groundwater flow at the down-gradient edge of the original source zone. See Figure 2 for groundwater sampling locations. Sampling locations will be approximately 20 feet apart, and at each location samples will be collected, as possible, on approximately 2 feet centers down to a maximum depth of 40 ft (and at least once in each distinct lithologic change suggested by the soil core). The samples will be analyzed via a headspace analysis on a gas chromatograph (GC) equipped with dry electrolytic conductivity detector (DELCD), photo-ionization detector (PID), and flame-ionization (FID) detectors. Analytes may include any or all of the following: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and vinyl chloride. If time permits, samples will be collected at additional locations as well. The specific depths and numbers of samples collected at each location may be adjusted depending on the analytical results in the field.
 - c. Aquifer specific-capacity tests will be conducted at each depth where a groundwater sample is collected. These tests will be conducted using the direct-push groundwater sampler and will involve the measurement of the steady flow rate achieved with a fixed drawdown; ideally, all tests will be conducted with the same fixed drawdown (usually 0.3 1.0 feet).

Table 1

	Existing Monitoring Well	Screen Interval (ft bls)	Well Diameter (in)	Water Level Measurement	Slug Test	Groundwater Sample
	MW-7	19.5-34.5	4	X	X	X
	MW-8	13-19	2	Х	X	X
	MW-9	26-32	2	X	X	X
	MW-10	28-34	2	X	X	X
Full-scale	MW-11	30-36	2	X	X	X
Application	MW-12	28-34	2	X	X	X
Monitoring	MW-13	30-36	2	X	X	X
Wells	MW-14	29.5-35.5	2	X	X	X
	WJETA062	24.9-29.9	4	X	X	X
	WJETA065	24.9-29.9	4	X		X
	WJETA066	24.7-30.2	4	X		X
	WJETA067	25.5-30.5	4	X	X	X
	MW-2		2	Х		X
	MW-3		2	X		X
	MW-4		2	X	X	X
A 11:4:1	MW-6		2	X		X
Additional Monitoring	WJET058	24.9-29.9	4	X		X
Wells	WJET059	24.15-28.65	4	X		X
,, 6115	WJET060	25.05-30.05	4	X		X
	WJET061	25.2-29.7	4	X		X
	WJET063	23.1-28.1	4	X		X
	WJET064	24.1-29-1	4	X		X

Note: -- Screened interval is unknown

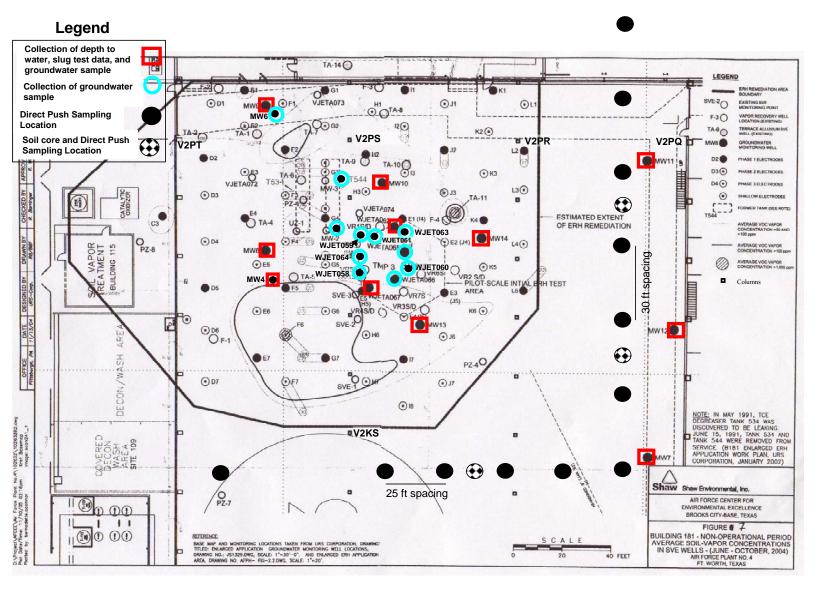


Figure 1

Health and Safety Plan (HASP) Air Force Plant 4 – Building 181

SECTION	N 1: GENERAL INFORM	ATION AND DISCLAIMER				
CLIENT (ESTCP)	NAME: Environmental Se	ecurity Technology Certificati	on Program	PROJECT	NAME: ESTCP Thermal Eval	uation
PRINCIP	AL INVESTIGATORS: E	ric Foote (Battelle) and Paul	Johnson (Arizona St	ate Universi	ty)	
PROJEC	Γ LEADER: Paul Dahlen					
PREPAR	ED BY: Sam Yoon			DATE: 10	0/09/2006	
NOTE:	Battelle is not responsible tasks, dates and personne Section 17. Subcontractors shall be s laws and regulations. In emergency response proc Specific Safety and Heal contractors and subcontra Hazard Communication and regulations; (2) prov	e for its use by others. The pl I specified. If these condition olely responsible for the healt accordance with 1910.120(b) edures, and any potential fire th Plan and site information o actors are responsible for: (1) Program and any other writter iding their own personal prote	an is written for the as change, a new plant the and safety of their (1)(iv) and (v), Batter, explosion, health, so btained by others avideveloping their own hazard specific projective equipment (PF	specific LE'n must be ut employees elle will info safety or oth ailable durir n Health and grams requi	er hazards by making this Site ng regular business hours. All I Safety Plan including a writter red by federal, state and local la iding documentation that their	s, med in sable
	providing evidence of me safety officer (SSO) resp	edical surveillance and medical	al approvals for their employees comply	employees;	tate and local laws and regulation and (5) designating their own s wn Health and Safety Plan and t	site
SECTION	N 2: PROJECT	INFORMATION				
(1)	SITE INFORMATION					
	Site ERH Test Sit	e at AF Plant 4	Site Project Conta	ict:	Richard Wice	
	Address Building 181 Air Force Pla	nt 4	Phone Number: Site Safety & Hea	e Safety & Health Shane Williams		
	Fort Worth,	TX 76108	Contact: Phone Number	-	O: 614-424-5792/ C: 614- 348-4437	
(2)	SITE CLASSIFICATION	N (check or circle all that	(3) ENTR	Y OBJECTI	VES (check or circle all that ap	oply)
apply)	 ✓ Hazardous (RCR Construction □ Landfill (Non-H UST/LUST) ✓ Manufacturing ✓ Active ✓ Inactive ✓ Other: military installa 	,	DATE(S) OF FIE VISIT(S):	Well Dril Sampling Sampling Sampling Other:	g, Water	
(4)	BATTELLE/ASU TASK	S	TASK PERF	FORMED B	Y OTHERS	
	B1. B2. Groundwater samp B3. Water level survey B4. Analytical activitie	ling and slug tests	01. <u>col</u> 02. <u>ID</u>	W disposal	ivities for gw sample	
(5)		ite. (Note: One person may ATORS Eri		one job func	designated to carry out the state ction.)	ed

	ALTERNATIVE SITE SAFE OFFICER(S)	ETY	Jennifer Triplett/	Paul Dahlen		
	PUBLIC INFORMATION O	FFICER	N/A			
	SITE RECORD KEEPER	TTTCLIC	Paul Dahlen/Jenr	nifer Triplett		
	SITE PERSONNEL WITH C	PR/FA	Shane Williams			
	DITE TERROTTINEE WITH	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	- Shane Williams			
	FIELD TEAM LEADER(S)		Paul Dahlen			
	OTHER FIELD TEAM MAN	NAGERS	Shane Williams			
	· · · · · · · · · · · · · · · · · · ·					
(6)					Battelle operations on site. And/or high-visibility barrier to	
	No unauthorized person shou	ld be within	this area.			
	The on site Command Post ar	nd staging ar	rea have been established a	the ERH tre	atment area near Building 181	at AF Plant 4.
					to determine daily wind direct ent exposure should a release	
	Control boundaries have been field by: traffic cones and/or			est of the ERI	H test area. These boundaries	are identified in the
SECTIO			- 			
(1)	IDENTIFY POTENTIAL PH	IYSICAL H	AZARDS TO WORKERS	(check or cir	rcle all that apply)	
	☐ Confined Space		eep/Uneven Terrain	$\sqrt{}$	Drums Handling*	
	√ Heavy Equipment		at Stress	$\sqrt{}$	Noise	
	Moving Parts	•	treme Cold		Non-Ionizing Radiation	
	☐ Heavy Lifting		nizing Radiation		Other:	
	□ Electrical	•	affic			
	√ Overhead Hazards		ological Hazards			
	☐ Fall (>6; Vertical)		rface Water (Immersion)			
	ards will be mitigated by:					
(9)) Briefing site personnel as to i	dentify phys	sical hazards within the wor	k area.		
	0) Identifying the "kill switch" of			_		
	1) Personal protection equipmer					ant atimas
(1.	2) Antiseptic ointment, solution	, and bug rep	beliefit (especially for ticks)) Will be inclu	ided in the first aid kit for inse	ect stings.
(2)	SAFETY EQUIPMENT REC	OUIRED FO	R BATTELLE/ASU EMP	LOYEES (ch	eck or circle all that apply)	
()	□ Explosimeter		e Wash		nfined Space Warning Signs	
	☐ Fall Protection	□ En	nergency Shower	√ Co	mmunications – On Site	
	Equipment					
	√ Barrier Tape		nergency Air Horn	√ Co	mmunications – Off Site	
	√ Traffic Cones	√ Lig	ghts	□ Otl	her:	
	Stretcher	□ Lig	ghts – emergency			
	√ First Aid Kit	□ La	dder			
	√ A-B-C- Fire		ck Repellant			_
	Extinguisher					_
	□ Snake Bite Kit		otation Device (USCG pe III)			
	ncy equipment will be located in pped with cellular telephones, wa					. The field crew will
SECTIO	ON 4: CHEMICAL HAZ	ZARDS INF	ORMATION			
(1)	IDENTIFIED CONTAMINA	NTS				
	Known or suspected hazardous/to	xic material	(attached historical inform	ation, physic	al description, map of contam	ination and
t	abulated date, if available). Media Substand	ces Involved	Characteristic	es	Estimated Concentrations	PEL

	GW	Chlorinated hydrocarbons (PCE,	VO and TO	VOCs	chlorinated up to 95,100	
		TCE, cis-1,2-DCE,			rior to the	
		trans-1,2-DCE, Vinyl chloride,1,1,1-TCA			peration,	
		1,1-DCE)			monitoring 4,000 µg/L.	
_	SL	Chlorinated	VO and TO		ch as 55,000	
	SL	hydrocarbons	vo and 10		prior to the	
		ny drovaroons			peration.	
_			-			
-		GW (ground water), SW (s	surface water), W	W (wastewater), AIR (air)	, SL (soil), SD (sediments),	
	Media types	WL (waste, liquid), WS (w				
	Characterizations	CA (corrosive, acid) CC, (c				
	Characterizations	(toxic), RE (reactive), BIO	(infectious), UN	(unknown), OT (other, de	scribe)	
					sheets include information on	
	the chemical/toxicolo	ogical properties of the site co	ontaminants and si	gns and symptoms of ove	r exposure.	
		TENTIAL FOR CONTACT V	WITH EACH ME	DIA TYPE FOR EACH (OF THE BATTELLE/ASU	
	TASKS LISTED IN	SEC 2.4:		DOTENTIAL FOR		
	BATTELLE TACK "	ROUTE OF EXPO	SURE	POTENTIAL FOR	METHOD OF CONTROL	L
	TASK #	Inhal/Inaast/Cantast	t/A baarb	CONTACT	Lavel D DDE	
	B1	Inhal/Ingest/Contact		High/Medium/Low	Level D PPE	
	B2	Inhal/Ingest/Contact		High/Medium/Low	Level D PPE	
	B3	Inhal/Ingest/Contact		High/Medium/Low	Level D PPE	
	B4	Inhal/Ingest/Contact		High/Medium/Low	Level D PPE	
		f the field team on interpretat	tion of the attached	d MSDSs and particularly	on symptoms and signs of	
CECTI	over exposure to c	enemical nazards. ARD COMMUNICATION P	DOCD AM			
SECTI				4 1 4 11 11		
	If chemicals are	introduced to the site by Batte	elle/ASU (e.g., de	contamination liquids, pro	eservatives, etc.), bring a copy of	
					SO will review this information	
	with all field per	sonnel. The current list of ch	emicals for this si	te is:		
	1,1,1-Trichloroe			Alcohol		
		nne, 1,1-dichloroethene (DCE	<u> </u>	Trichloroethene		
	HCL (preservati	ve)		Tetrachloroethene		
	Liquinox®			1,2-dichloroethene (cis	- and trans-), Vinyl	
				chloride		
SECTI	ON 6. ENVI	RONMENTAL MONITORI	NG			
(1)	The following er	vironmental monitoring instr	ruments shall be u	sed on site at the specified	d intervals for breathing zone monitor	oring:
	EQUIPMENT	MONITOR	RING PERIOD		ACTION LEVEL	
	Combustible Gas					
	Indicator		continuous/other		<u> </u>	
	O ₂ Meter		continuous/other		<u></u>	
$\sqrt{}$	PID (Lamp10.	6_				
	eV)	daily/ hourly/	continuous/other			
	FID	daily/hourly/	continuous/other			
	Radiation Meter	uuriy/110 uriy/		-		
	(Gamma)	daily/hourly/	continuous/other			
	Respirable Dust Me					_
		3	continuous/other			
	GC/ECD/FID		continuous/other			
√ _	GC/FID/PID/DELC	D daily/ hourly/	continuous/othe r		<u></u>	
		daily/hourly/e	continuous/other			
_					<u> </u>	
(6)	Monitoring equi	oment is to be calibrated acco	ording to the manu	facturers' instructions da	lly prior to and after each day of	
` /		bration data and air concentra				
(7)				3		
(')		r work shutdown and excavat	fion These are av			
	Action Levels fo	r work shutdown and excava-			icts Levels are for persistence (>	
	Action Levels fo potential for rele				icts. Levels are for persistence (>	
	Action Levels fo				`	
	Action Levels for potential for rele 10 min).	ase of highly toxic compound			ACTION LEVEL	
	Action Levels for potential for rele 10 min). Uncharacterized	ase of highly toxic compound Airborne Vapors or Gases			ACTION LEVEL >Background	
	Action Levels fo potential for rele 10 min). Uncharacterized Characterized A	ase of highly toxic compound			ACTION LEVEL >Background >50% PEL, REL,	
	Action Levels fo potential for rele 10 min). Uncharacterized Characterized A Particulates	ase of highly toxic compound Airborne Vapors or Gases			ACTION LEVEL >Background >50% PEL, REL, TLV	
	Action Levels fo potential for rele 10 min). Uncharacterized Characterized A	ase of highly toxic compound Airborne Vapors or Gases			ACTION LEVEL >Background >50% PEL, REL,	

(6)	health and safety reached at the wo in charge or their	ivilian personnel in charge kick-off meeting of site ac ork area as described above designated representative I to assess whether organic	ctivities. e or if dis will be r	A copy of this HASI scernible odors are relatified immediately.	P will be prov leased as a res Hourly perin	ided. If any action sult of field activition neter monitoring (s	levels are es, the personnel	
SECTION The proje	N 7: HEAL	TH AND SAFETY TRAIn the Battelle Health and	NING/N	MEDICAL MONITOR	RING PROGI Monitoring P	RAM rograms in conform	nance with 29	
				HAZW	OPPER TRA	AINING		
	NAME	MEDICAL		INITIAL		REFRESHER	CPR/FA/	
Eric F	laata	(Date)		(Hrs/Date) 40 hours/ 1992	T.	(Date)	(Dates)	
EHCF	oote	August 2006		40 Hours/ 1992	Jt	ine 2006	May 2004 (good for 3 years)	
Shane	Williams	February 2006	_	40 hours/April		ıly 14, 2006	July 2006	
Snanc	· · · · · · · · · · · · · · · · · · ·	1 Cordary 2000		1994		11, 11, 2000	(good for 3 years)	
Jennif	er Triplett		_	40 hours/June 2001	(I	ugust 7, 2005 Refresher sched. or Nov. 2006)		
Paul I	Dahlen		_	40 hours/Nov 1992		ebruary, 2006		
Paul J	ohnson		<u> </u>	40 hours/ 1987	(H	ugust 12, 2005 Refresher sched. or Jan. 2007)		
SECTION	IO DEDG	ONAL MONITORING						_
SECTION		ONAL MONITORING rsonal exposure monitorin	a ar haat	t/aald atraca manitaris	a a vvill talca m	laga an aita. If tha	mond for auch	
		oring is anticipated, this H				lace on site. If the	need for such	
SECTION		FINED SPACE ENTRY	ASI WII	i de illoutried as acco	idiligiy.			_
SECTION		nfined space and/or trench	entries v	will take place on site	If the possil	bility of such entrie	s taking place	
		this HASP will be modifi			p	,		
SECTION	N 10: COM	MUNICATION PROCED	URES	-				
	The following sta	ndard hand signals will be	used in	case of failure to radi	o communica	tions in each conta	minant	
	reduction zone:							
	Hand gripp					ılk, Having difficul		
		r's wrist and both hands a	round wi	rist		ılk, Leave area imn	nediately	
	Hands on to				Need ass			
	Thumbs up					n all right, I unders	tand	
	Thumbs do	wn phone communications to	tha Cam	mand Doot Chould ha	No, nega		The stationary	
		one number(s) will be avai						
	when these numb		iauic oii	week prior to the sta	iit oi iicid wo	ik. The HASI wii	i be amended	
	The command po		16-1422					
	The mobile phon							
	1							
SECTION	N 11: DECC	ONTAMINATION PROCE	EDURES	S				
	Personnel and equ	uipment leaving an exclusi	on zone	shall be thoroughly d	econtaminate	d at the decontamin	nation facility	
	constructed at the	command post. The SSO	is respo	nsible for monitoring	adherence w	ith this decontamin	ation plan. A	
		decontamination protoco		used with the follow	ing decontan	nination stations:		
		nent Drop (IF NECESSAF						
		overs, and Glove Wash ar	d Rinse	(IF				
		SSARY) Boot and Glove Removal (IE NECI	ECCADV)				
		Garment Removal (IF NEC						
		Glove Removal (IF NECES		.1)				
		Iand Wash	, ,					
	The following	decontamination equipmen	nt is requ	ired (check or circle	all that annly)		
		• •	•	•				
		con Pad (Plastic Sheet)		Dry Brushes	√ _	Detergent Soap		
		sh Cans/Bags	√,	Wet Brushes		Other Decontam	ination Solution	
	√ Buc	ekets	\checkmark	Water				
SECTION	J 12. EMET	RGENCY PROCEDURES						_
SECTION		will use the following star		nergency procedures	The SSO che	all be notified of an	y on site	
		be responsible for ensuring				in oc nouncu or all	y 011 5110	
1	Personal Inju	-	,	DESIGNATED EM		Air Horn		
1		-		SIGNAL:				
	Exclusion	Zone						

Upon notification of an injury in the Exclusion Zone, the designated emergency signal shall be sounded. All site personnel shall assemble at the decontamination line. The SSO or alternate should evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the Support Zone. The on site CPR/FA personnel shall initiate the appropriate first aid, and contact should be made for an ambulance (and other emergency services as needed) and with the designated medical facility (if required). No persons shall reenter the Exclusion Zone until the cause of the injury or symptoms are determined.

Fire/Explosion

DESIGNATED EMERGENCY SIGNAL:

Air Horn

Upon notification of a fire or explosion on site, the designated emergency signal shall be sounded and all site personnel assembled at the decontamination line. The fire department shall be alerted and all personnel moved to a safe distance from the involved area

Equipment Failure

If any other equipment (i.e., air monitoring) on site fails to operate properly, the Field Team Leader and SSO shall be notified and then determine the effect of this failure on continuing operations on site. If the failure affects the safety of personnel or prevents completion of the Work Plan tasks, all personnel shall leave the Exclusion Zone until the situation is evaluated and appropriate actions taken.

Emergency escape routes are designated for use in those situations where egress from the Exclusion Zone cannot occur through the decontamination line

In all situations, when an on site emergency results in evacuation of the Exclusion Zone, personnel shall not reenter until:

- The conditions resulting in the emergency have been corrected.
- The hazards have been reassessed by the SSO.
- The Site Safety Plan has been reviewed by the SSO and Corporate Health and Safety Manager.

Shane Williams

SECTION 13: SPILL CONTROL PROCEDURES No containers of liquid or solids exist on site and no spill control plan is necessary. If the possibility of such conditions exists on site, this HASP will be modified accordingly. SECTION 14: **EMERGENCY INFORMATION** (1) LOCAL RESOURCES

Ambulance (name):	LM Aero Emergency Services	Phone:	911 or (817) 777-3473
Hospital (name):	Harris Methodist Hospital	Phone:	911 or (817) 250-3333
Police (local or state):	LM Aero Security	Phone:	911 or (817) 777-2567
Fire (name):	LM Aero Fire Department	Phone:	911 or (817) 777-2163
HAZ MAT Responder:	National Response Center,	Phone:	911 or (800)424-8802
	Toxic Chemicals and Oil		
	Spills		

For life-threatening emergencies or emergency trauma care.

The above hospital is approximately 9.4 miles from the furthest work area and the ambulance response time is approximately 17 minutes.

Phone:

614-348-4437

For non-life threatening medical care.

On-Site CPR/FA(s):

The above hospital is approximately 30 minutes from the furthest work area. Injured workers will be transported here for non-emergency treatment only.

DIRECTIONS TO NEAREST HOSPITAL - SEE ATTACHED MAP:

Figure 1.

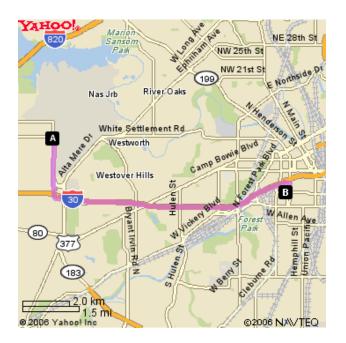
BATTELLE RESOURCES

Manager, Corporate Health and Safety (ETE Division) Site Contact: Eric Foote: 614-424-7939

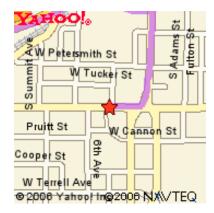
Gary Carlin, 614-424-4929

Battelle Security Office (614) 424-4444

SECTION 15 √	No type of respiratory	TIVE EQUIPMENT (cherotection is required on EP will be modified accordingly)	this site. If		need for	respiratory protection	
C	LOTHING	GLOVES	rumgry.	BOOTS		OTHER	
□ Covera□ Tyvek□ Saranes	$\sqrt{}$	Cotton Leather Nitrile	√ □ □	Safety Fireman/Hip Neoprene	$\sqrt{}$	Hard Hat Glasses Goggles	
☐ PE Tyv ☐ Other:		Butyl Neoprene Viton	\checkmark	Steel Toe	\bigvee^{\square}	Face Shield Hearing Protection	
		PVC PVA					
SECTION 16	: SAFE WORK PRACT						
23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33.	Smoking, eating, chewing gum Ignition of flammable liquids w Contact with samples, excavate Use of contact lenses is prohibi Do not kneel on the ground who If drilling equipment is involve All electrical equipment used ir interrupter (GFCI) protected ou A "Buddy System" in which an Good housekeeping practices at Where the eyes or body may be available for immediate use. In the event of treacherous wea heat) the field task will be suspective of the content of the cont	or tobacco, or drinking a ithin or through improvised materials, or other contied at all times. In collecting samples. It, know where the kill swootside locations, wet an outside locations, wet an outside locations, wet an outside locations are to be maintained. In exposed to corrosive matcher-related working contended until conditions im	are forbidder sed heating taminated m witch is. reas, or near ough to rend aterials, water ditions (i.e.,	except in clean or devices (e.g., barrels aterials must be min water must be plugger immediate aid will er suitable for quick of thunderstorm, limite	is forbid imized. ged into g Il be in eff drenching	round fault circuit fect. or flushing shall be	
H&S Mar	nager: Linc	Remmert			=		
Project Le Site Safet	eader: Paul	Foote; Paul Johnson Dahlen e Williams			- - 	tond the cite he J-	
as	described and agree to comply velocities (Print Name)	with the contents of the p	of form and blan. JATURE	ine attached MSDSs	. Tunders	DATE	
	VISITOR (Print Name)	SIGN	IATURE			DATE	
Organ	ization/Agency						
Organ	ization/Agency						



Harris Methodist Hospital 1301 Pennsylvania Avenue Fort Worth, TX 76104-2122 Emergency Room Phone No. (817) 882-3333



1.	Start at 1 S GRANTS LN, FORT WORTH on S Grants Ln going toward Wyatt Dr - go 0.2 mi
2.	Bear Left on Ramp - go 0.1 mi
3.	Continue on S Spur 341 - go 1.1 mi
4.	S Spur 341 becomes Ramp - go 0.4 mi
5.	Bear Right on Interstate 30 W - go 0.2 mi
6.	Take Left ramp onto I-30 - go 5.2 mi
7.	Take the Summit Ave/Henderson St exit onto Ramp - go 0.5 mi
8.	Take ramp onto Ramp - go 0.2 mi
9.	Turn Right on S Henderson St - go 0.2 mi
10.	Turn Right on Pennsylvania Ave - go 0.1 mi
11.	Arrive at 1301 PENNSYLVANIA AVE, FORT WORTH, on the Left

Figure 1. Directions to a nearest clinic

Draft Final

Data Analysis Report of Air Force Plant 4 – Building 181

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:
Arizona State University
Battelle Memorial Institute

February 2007

The vendors and products, including the equipment, system components, and other materials identified in this report, are primarily for information purposes only. Although some of these vendors and products may have been used in the past, mention in this report does not constit a recommendation for using these vendors or products.	e

Contents

Figures	24			
Tables 12	24			
Acronyms and Abbreviations	26			
1. Introduction Error! Bookmark not define	d.			
2. Field Investigation	27			
3. References 13	31			
Figures				
FIGURE 1. SITE MAP				
FIGURE 2. DIRECT-PUSH LOCATIONS				
FIGURE 3. HYDRAULIC CONDUCTIVITY MEASUREMENT LOCATIONS				
FIGURE 4. MONITORING WELL DEPTH-TO-WATER MEASUREMENTS AND GROUNDWATER	:			
SAMPLING LOCATIONS				
FIGURE 5. CROSS-SECTION OF DIRECT PUSH SAMPLING LOCATIONS				
FIGURE 6. VINYL CHLORIDE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (µG/L)				
Figure 7. 1,1-Dichloroethene Direct-Push Groundwater Concentrations (μ g/L)				
Figure 8. trans-1,2-Dichloroethene Direct-Push Groundwater Concentrations (μ G/L)				
Figure 9. 1,1-Dichloroethane Direct-Push Groundwater Concentrations (μ G/L)				
Figure 10. cis-1,2-Dichloroethene Direct-Push Groundwater Concentrations (μ G/L)				
FIGURE 11. 1,2-DICHLOROETHANE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (μG/L)				
FIGURE 12. 1,1,2-TRICHLOROETHANE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (
FIGURE 13. TRICHLOROETHYLENE DIRECT-PUSH GROUNDWATER CONCENTRATIONS (µG/				
FIGURE 14. HYDRAULIC CONDUCTIVITY TEST DATA (CM/S) OVERLAIN ON TRICHLOROET	HYLENE			
CONTOUR PLOT				
FIGURE 15. MASS FLUX TOOLKIT INPUTS				
Tables				
TABLE 1. GEOLOGIC DESCRIPTIONS OF CONTINUOUS SOIL CORES				
TABLE 2. SAMPLING LOCATIONS AND TYPES OF TEST PERFORMED				
TABLE 3. SLUG TEST FIELD RESULTS				
TABLE 4. DEPTH-TO-GROUNDWATER MEASUREMENTS FOR MONITORING WELLS				
TABLE 5. WATER QUALITY DATA FOR MONITORING WELLS				
TABLE 6. CHEMICAL CONCENTRATION DATA FOR MONITORING WELLS				
TABLE 7. SURVEY DATA FOR DIRECT PUSH DOWNGRADIENT TRANSECT LOCATIONS				
TABLE 8. CHEMICAL CONCENTRATION DATA FOR DIRECT PUSH DOWNGRADIENT TRANSP	ECT			

LOCATIONS

- TABLE 9. WATER QUALITY DATA FOR DIRECT PUSH DOWNGRADIENT TRANSECT LOCATIONS
- TABLE 10. FIELD DATA RESULTS FOR PNEUMATIC SLUG TESTING
- TABLE 11. MONITORING WELL CHEMICAL CONCENTRATION DATA COMPARISON
- TABLE 12. MASS FLUX ANALYSIS

Acronyms and Abbreviations

AFP Air Force Plant

bgs below ground surface

DCA 1,1-dichloroethane DCE 1,2-dichloroethene

DNAPL dense non-aqueous phase liquid

DO dissolved oxygen

DELCD dry electrolytic conductivity detector

EC electrical conductivity
ERH electrical resistance heating

ESTCP Environmental Security Technology Certification Program

FID flame-ionization detector

GC gas chromatography

ORP oxidation reduction potential

PID photo-ionization detector

TCA trichloroethane TCE trichloroethylene

VOA volatile organic analysis

1. Introduction

The post-treatment field investigation of Air Force Plant 4 (AFP4) – Building 181, under the Environmental Security Technology Certification Program (ESTCP) project CU-0314, *Critical Evaluation of State of the In-Situ Thermal Treatment Technologies*, was performed December 4 through December 14, 2006. Figure 1 is a site map that identifies the extent of the previous electrical resistance heating (ERH) remediation area, which was the specific area of interest for this particular field investigation.

Consistent with the objectives set forth under the CU-0314 Demonstration Plan, the field investigation at this site included the following:

- Verification of site hydrogeological conceptual model
- Groundwater sampling of monitoring wells
- Depth-discrete analysis of hydraulic conductivity and dissolved chlorinated hydrocarbons at temporary sampling locations downgradient of the treatment zone.

2. Field Investigations

In accordance with the approved generic demonstration plan for this project, the following sitespecific activities were conducted:

- (3) Verification of the site hydrogeological conceptual model:
 - b. For confirmation of geology, three continuous soil cores were collected at direct-push sampling locations GP1, GP3 and GP6. The continuous soil cores/ direct-push sampling locations were located at the down-gradient edge of the treatment zone. Figure 2 shows the location of each direct-push location. Table 1 presents qualitative geologic descriptions from visual observations of the three continuous soil cores.
 - c. Hydraulic conductivity slug tests were conducted in the nine monitoring wells identified in Table 2 and illustrated in Figure 3. The slug test data was analyzed using both the Hvorslev and the Bouwer and Rice Methods; results are presented in Table 3. Hvorslev's expression for hydraulic conductivity is:

$$K = (r^2 \ln(L_e/R))/(2L_e t_{37})$$

Where

K = hydraulic conductivity (L/T)

r = radius of well casing (L) (0.083 or 0.1667 ft)

R = radius of well screen (L) (0.50 ft)

L_e = length of well screen (L) (4.5, 5, 6, 10 ft or the saturated thickness if well screen was not completely covered)

 t_{37} = time for water level to rise or fall 37% of the initial change (T) (from data set)

(Fetter, 2000).

The Bouwer and Rice expression for hydraulic conductivity is:

$$K=(r_c^2 \ln(R_e/R) / (2L_e)) * ((1/t) \ln(H_o/H_t))$$

Where K = hydraulic conductivity (L/T)

 r_c = radius of well casing (L) (0.083 or 0.1667 ft)

R = radius of gravel envelope (L) (0.50 ft)

R_e = effective radial distance over which head is dissipated (L) (from data set)

L_e = length of well screen (L) (4.5, 5, 6, 10 ft or the saturated thickness if well screen was not completely covered)

 $H_0 = drawdown at t=0 (L) (from data set)$

 $H_t = drawdown at t=t (L) (from data set)$

 $t = time since H = H_o (T) (from data set)$

(Fetter, 2000).

It should be noted that two of the slug test locations, monitoring well WJETA062 and WJETA067, were partially-penetrating wells having only partially-submerged screens and about 1.5 ft of water in each. In contrast, two other slug test locations, monitoring well MW-7 and MW-12, were fully-penetrating wells with partially submerged screens. Corrections were made in the Bouwer and Rice analysis for these two types of wells:

- i. For the partially-penetrating wells, the approach discussed in Bouwer (1989) was used, and
- ii. For MW-7 and MW-12, the fully-penetrating wells with only partially-submerged screens, a correction to the porosity was made by replacing it with the specific yield as suggested by Binkhorst and Robbins (1998).

The Bouwer and Rice expression modified for partially-submerged screens is:

$$K=(r_{ce}^{2} ln(R_{e}/R) / (2L_{e})) * ((1/t) ln(H_{o}/H_{t}))$$

Where

$$\begin{split} &r_{ce}^{\ 2} = \ r_{c}^{\ 2} + S_{y} (R^{2} - r_{c}^{\ 2}) \\ &S_{y} = \ (V_{wc} / V_{s)} = (r_{c}^{\ 2} (H_{oc} - H_{i})) \ / \ ((R^{2} - r_{c}^{\ 2}) H_{i}) \\ &V_{wc} = \ \pi^{*} r_{c}^{\ 2} (H_{oc} - H_{i}) \\ &V_{s} = \ \pi \ (R^{2} - r_{c}^{\ 2}) H_{i} \\ &H_{oc} = \ V_{sr} / (\pi^{*} r_{c}^{\ 2}) \end{split}$$

Where K = hydraulic conductivity (L/T)

 H_i = length of desaturated sand column (L) (from data set)

 H_{oc} = calculated initial head difference (L)

 V_{sr} = volume of slug removed (L³)

 V_s = volume of sand (L^3)

 V_{wc} = volume drained into casing (L³)

 S_v = specific yield

 r_{ce} = effective casing radius (L)

 r_c = radius of well casing (L) (0.083 or 0.1667 ft)

R = radius of gravel envelope (L) (0.50 ft)

R_e = effective radial distance over which head is dissipated (L) (from data set)

L_e = length of well screen (L) (saturated thickness of screened interval)

 $H_0 = drawdown at t=0 (L) (from data set)$

 $H_t = drawdown at t=t (L) (from data set)$

t = time since $H = H_0(T)$ (from data set)

(Binkhorst and Robbins. 1998).

- d. Depth-to-groundwater was measured in the 18 groundwater monitoring wells identified in Table 2 and illustrated in Figure 4. Depth-to-water measurements, groundwater elevations, and survey coordinates are summarized in Table 4. An interpolated groundwater elevation map is presented in Figure 5.
- (4) Collection of water quality samples from 15 groundwater monitoring wells within the treatment zone and 3 monitoring wells downgradient of the treatment zone for analysis of chlorinated hydrocarbon groundwater concentrations:
 - a. Table 2 identifies the groundwater monitoring wells from which samples were collected. Prior to sample collection, three well-volumes were purged. Groundwater was then collected for analysis of field parameters and stored in volatile organic analysis (VOA) vials for analysis of dissolved chlorinated hydrocarbon concentrations. General water quality field parameters including pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP) were measured using an Horiba U-22 meter. Chlorinated hydrocarbon analysis was performed on-site by heated-headspace analysis and gas chromatography (GC) using a dry electrolytic conductivity detector (DELCD), a photo-ionization detector (PID), and a flame-ionization detector (FID). General water quality data for permanent groundwater monitoring well installations can be found in Table 5 and chemical concentration data can be found in Table 6. All non-detect samples are listed as less than the detection limit
- (5) Depth-discrete hydraulic conductivity and dissolved chlorinated hydrocarbon concentration data were collected on one foot intervals as possible from 29 ft below ground surface (bgs) to refusal (<35 ft bgs) at four of the 11 direct-push sampling locations, many of which produced no water. Depth-discrete intervals at 7 of the 11 sampling locations produced no water at any interval tested. Additionally, 10 composite samples were collected from the borehole open to approximately 35 ft bgs at 10 of the 11 direct-push sampling locations.

- a. Groundwater quality data were collected from depth-specific intervals at directpush sampling locations GP3, GP4, GP6, and GP7 and open-borehole, composite samples were collected at GP1 through GP9 and GP11 (See Table 2 and Figure 2). GP10 was not sampled because there was no groundwater recovery in the borehole. Sampling locations were spaced on approximately 30 ft centers, as possible, along a transect downgradient of the source zone and perpendicular to the direction of groundwater flow. Figures 2, 6, and 7 illustrate the location of the direct-push sampling locations. Sample locations were also placed along an east/west transect at the southern border of the treatment zone because previous work by others suggested the presence of a paleo channel and chlorinated solvent migration in that direction. Using percussion assisted direct-push technology and a modified Geoprobe Groundwater Profiler, groundwater samples were collected as possible using a check valve on 1-ft intervals from 29 ft bgs to refusal (less than 35 ft bgs). The location of the depth-discrete groundwater samples are illustrated in Figures 6 and 7. Table 7 provides survey data for the direct-push locations. Chlorinated hydrocarbon concentration analysis was conducted, as described above, and the results are summarized in Table 8. General water quality parameters (e.g. pH, EC, temp, DO, and ORP) were also collected during depth-specific sampling, and those data are presented in Table 9.
- b. Pneumatic slug tests were conducted at depth-specific intervals at locations GP3, GP4, GP6, GP7 and GP11 using a Geoprobe Pneumatic Slug Test Kit. Slug test data were analyzed using both the Hvorslev and the Bouwer and Rice Methods, and the results are shown in Table 10. A comparison of the hydraulic conductivities derived from direct-push pneumatic slug test and monitoring well slug tests reveals that direct-push aquifer test data suggest less variable and higher hydraulic conductivity values than those derived from the monitoring well data. It is possible that this is an artifact of the direct-push pneumatic test method, which displaces much smaller volumes of water than the monitoring well tests.

Additional field work included soil conductivity measurements at GP1 and GP6 using a Geoprobe Direct Image Electrical Conductivity Probe (Wenner array). Results of the soil conductivity tests are shown in Figure 8.

The monitoring well chemical concentration data collected in December 2006 by the ASU/Battelle team were compared to the previous monitoring well chemical concentration data available for the site. The results for each are compared in Table 11.

Figures 9 through 13 show vertical chemical concentration contour plots in a transect perpendicular to the dominant groundwater flow direction for five of the ten analytes measured in depth-discrete direct-push samples. Vinyl chloride, trans-1,2-dichloroethene (DCE), 1,1-dichloroethane (DCA), 1,2-DCA, and 1,1,2-Trichloroethane (TCA) were not contoured because all groundwater samples were non-detect (<1 µg /L) for these constituents. Vertical contouring did not include locations GP1, GP2 or GP9 along the southern border of the treatment zone since no depth specific samples could be collected from these locations and chemical and hydrogeologic data suggested that the dominant flow direction for this site was to the east-

northeast. Figure 14 presents the hydraulic conductivity data from the pneumatic slug testing for each depth-discrete direct-push sampling interval overlaid on the trichloroethylene (TCE) chemical concentration contour plot.

Plan view contour plots of the chemical concentrations for 8 of 10 analytes measured in 15 monitoring wells and at direct-push sampling locations GP1 through GP9 and GP11 are shown in Figures 15 through 22. Vinyl chloride and 1,1,2-TCA were not contoured because all groundwater samples were non-detect ($<1 \mu g/L$) for these constituents.

Using the TCE groundwater concentration data, the hydraulic conductivity estimates calculated from the depth-discrete direct-push sampling and monitoring well slug tests, and a calculated gradient, a TCE mass flux calculation was performed using the Mass Flux Toolkit, Version 1.0. The gradient was calculated using Devlin (2003) and was based on current depth-to-water measurements and available historical top-of-casing elevations for all monitoring wells except MW-9 and MW-10. Depth-to-water data in MW-9 and MW-10 showed a steep gradient across that portion of the site, suggesting a localized hydrogeologic environment that was incongruent with that associated with the remainder of the monitoring wells. The Mass Flux Toolkit is a freeware program developed by Groundwater Services, Inc. and others under a contract funded by ESTCP. A linear spatial and vertical interpolation of the concentration, hydraulic conductivity, hydraulic gradient, and mass flux data was used for the analysis. For intervals with no groundwater production, a hydraulic conductivity value of 10⁻⁶ cm/s (average value, MW-9 and MW-10, the least conductive wells). The analysis was completed four times to include all data taken at the site. The first analysis used the Bouwer and Rice Method hydraulic conductivity values with monitoring wells, MW-11, MW-12, and MW-7. The second analysis used the Bouwer and Rice Method results for the direct-push locations only (no monitoring well results). The same two analyses were performed again using the Hvorslev Method hydraulic conductivity values. Table 12 presents the mass flux results for TCE in each of the four analyses. For these four calculations, the estimated TCE mass flux ranged from 4.92E+00 kg/yr to 1.09E+01 kg/yr. The highest value corresponds to the case where the monitoring well data is used, and it is dominated by the large hydraulic conductivity calculated by the Bouwer (1989) approach using MW-12 slug test data.

3. References

- Devlin, J.F. 2003. "A Spreadsheet Method of Estimating Best-fit Hydraulic Gradients Using Head Data from Multiple Wells." Groundwater, 41(3): 316-320.
- Binkhorst, G.K. and G.A. Robbins. 1998. "Conducting and Interpreting Slug Tests in Monitoring Wells with Partially Submerged Screens." Groundwater, 36(2): 225-229.
- Fetter, C.W. 2000. Applied Hydrogeology. 4th ed. Upper Saddle River, New Jersey: Prentice-Hall. pp.197-200.
- Bouwer, H. 1989. "The Bouwer and Rice Slug test An Update." Groundwater, 27(3): 304-309.

Figures

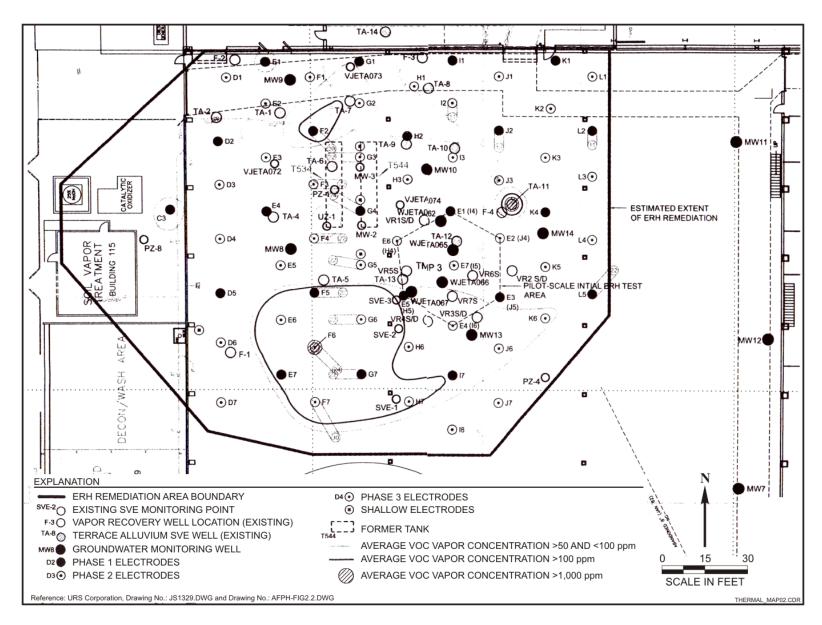


Figure 1. Site Map

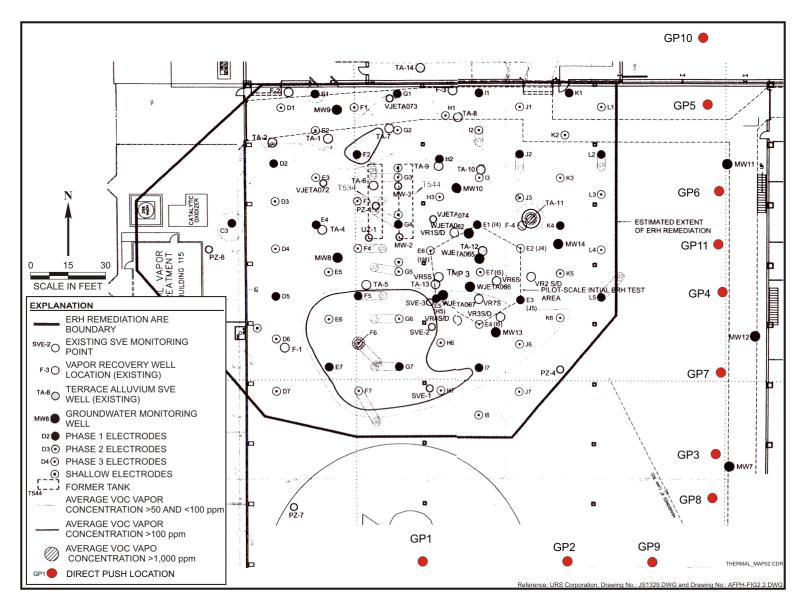


Figure 2. Direct-Push Locations

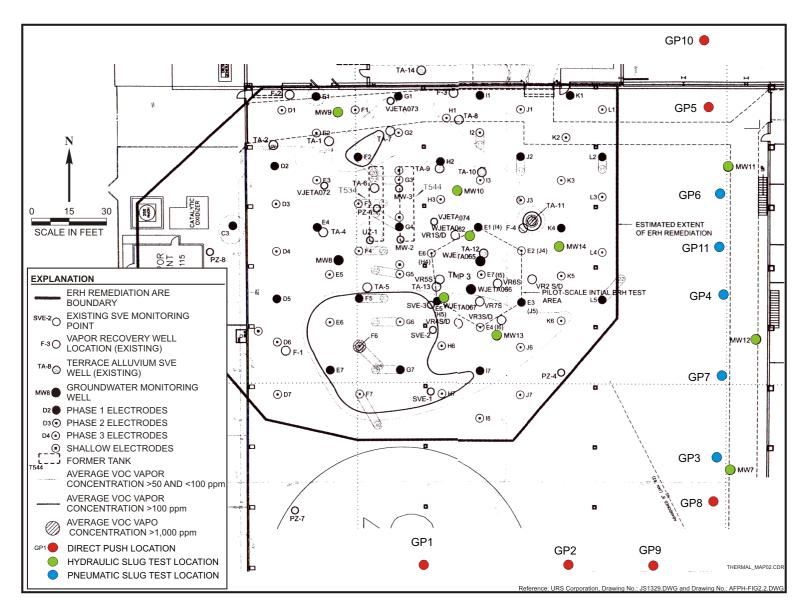


Figure 3. Slug Test Locations

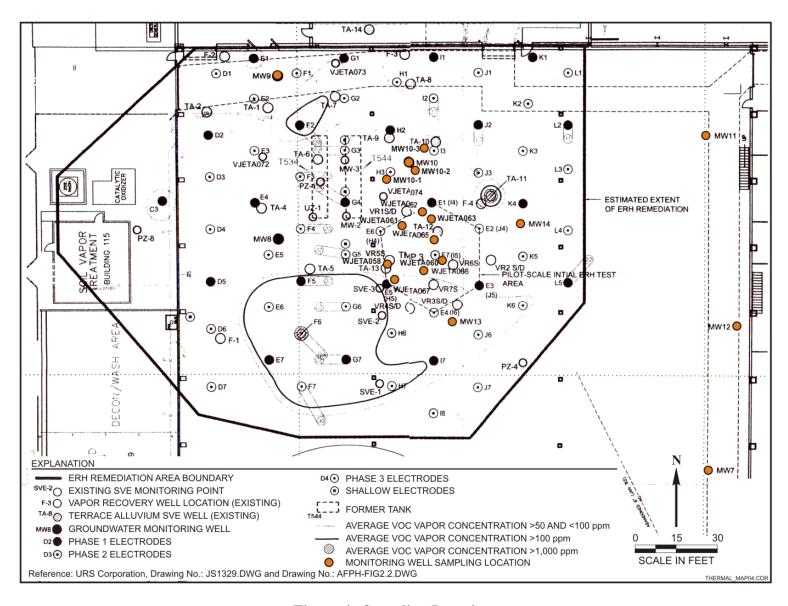


Figure 4. Sampling Locations

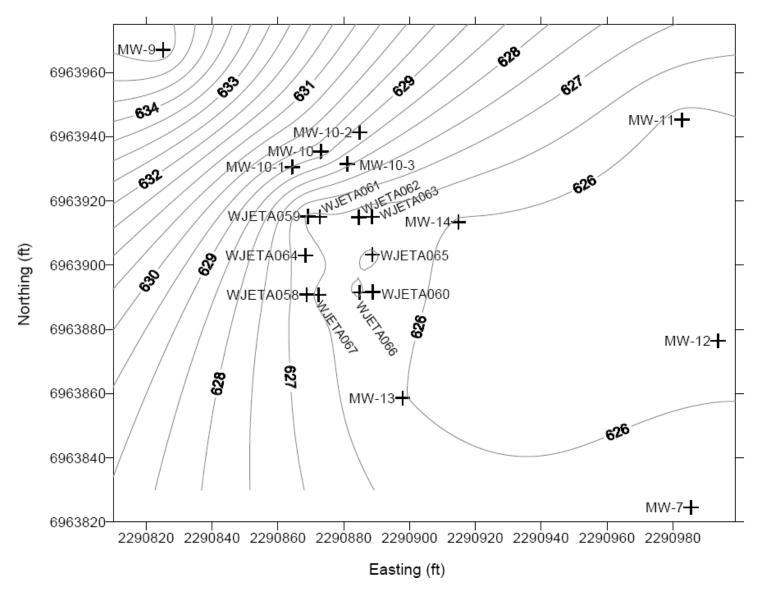


Figure 5. Interpolated Groundwater Elevation Map

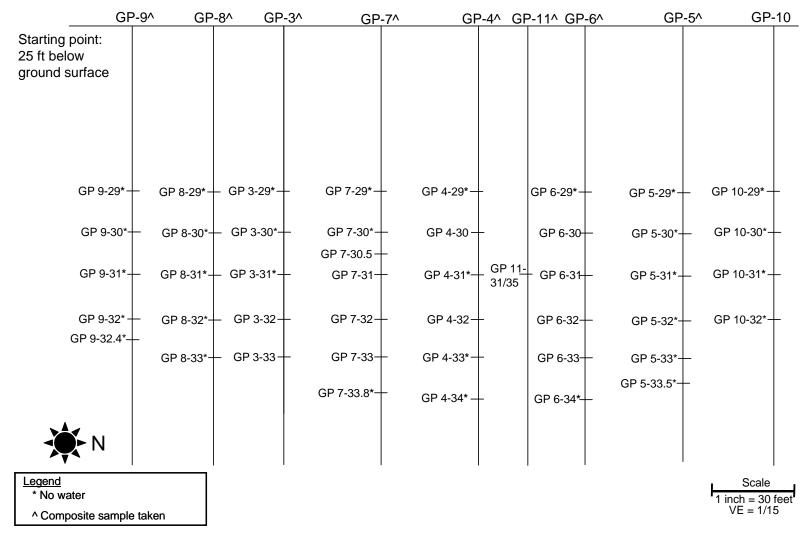


Figure 6. North/South Cross-Section of Direct-Push Sampling Locations (East of the Electrical Resistance Heating Application)

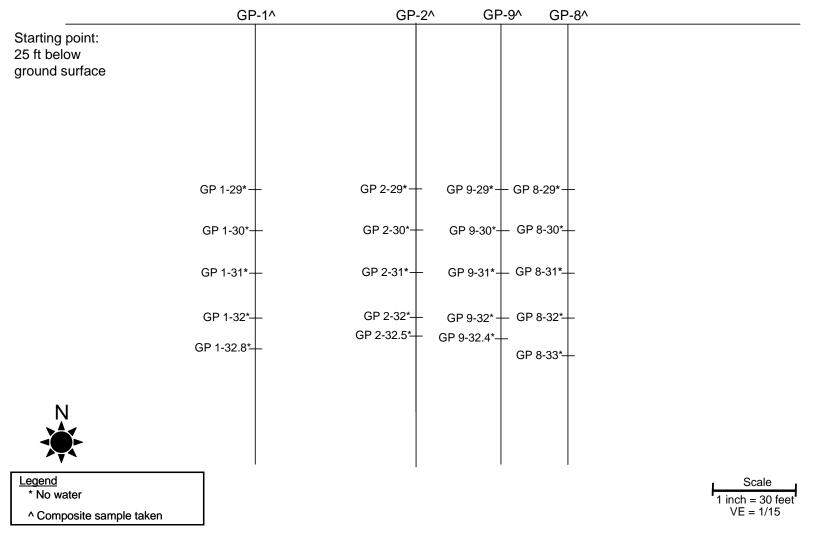
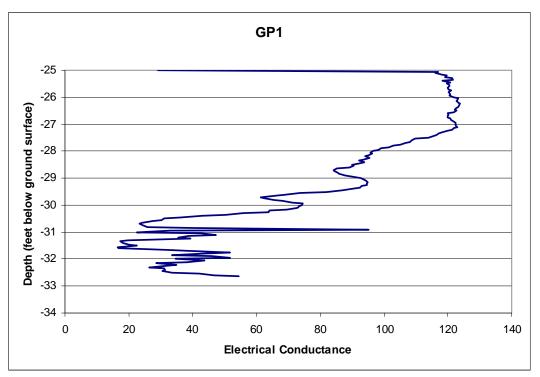
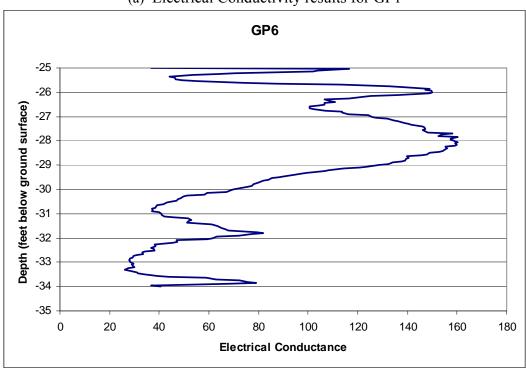


Figure 7. East/West Cross-Section of Direct-Push Sampling Locations (South of the Electrical Resistance Heating Application)



(a) Electrical Conductivity results for GP1



(b) Electrical Conductivity results for GP6

Figure 8. Electrical Conductivity Results

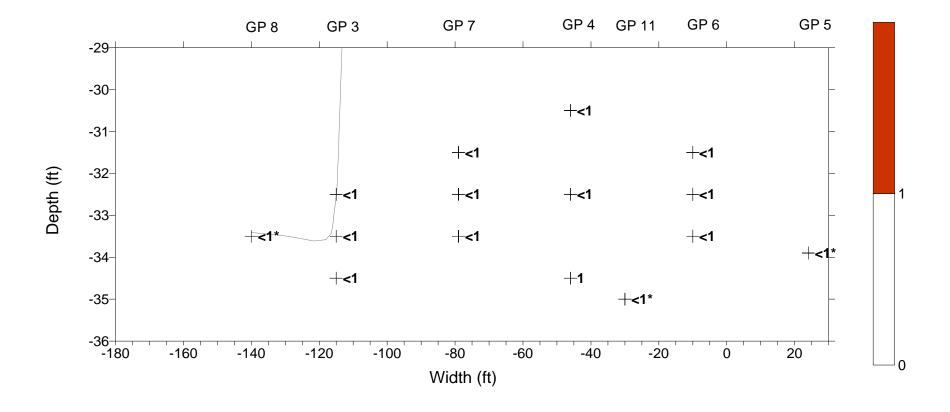


Figure 9. 1,1-DCE Direct-Push Groundwater Concentrations (µg/L)

^{*} Composite sample of the open borehole

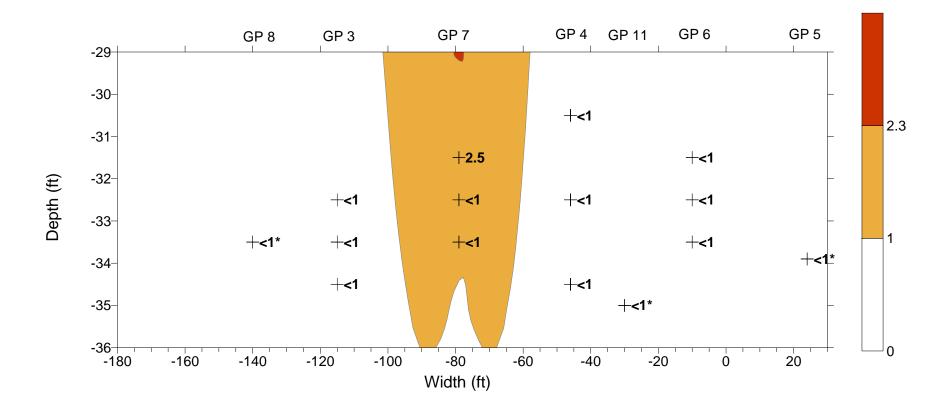


Figure 10. cis-1,2-DCE Direct-Push Groundwater Concentrations (µg/L)

^{*} Composite sample of the open borehole

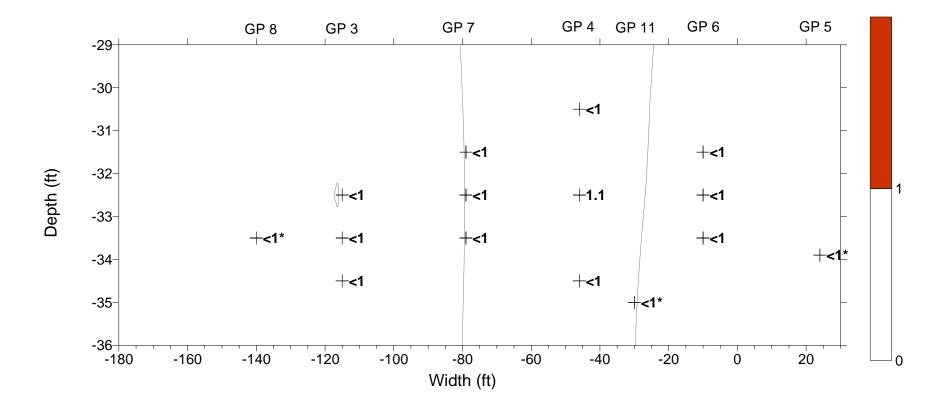


Figure 11. 1,1,1-TCA Direct-Push Groundwater Concentrations (µg/L)

^{*} Composite sample of the open borehole

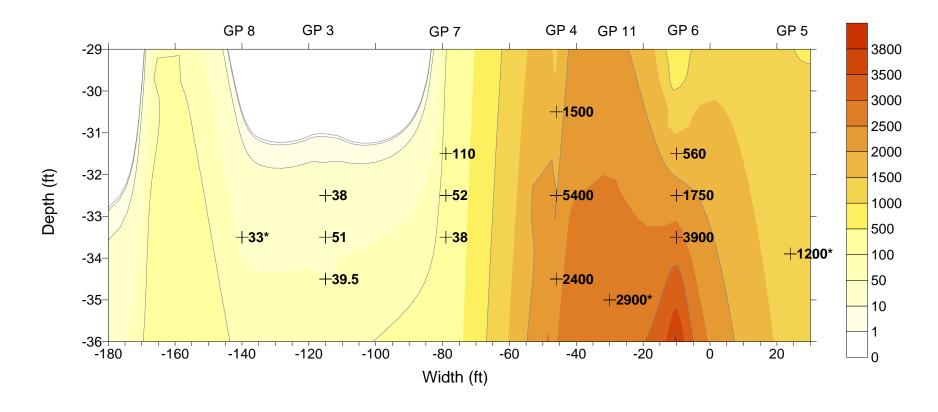


Figure 12. TCE Direct-Push Groundwater Concentrations (µg/L)

^{*} Composite sample of the open borehole

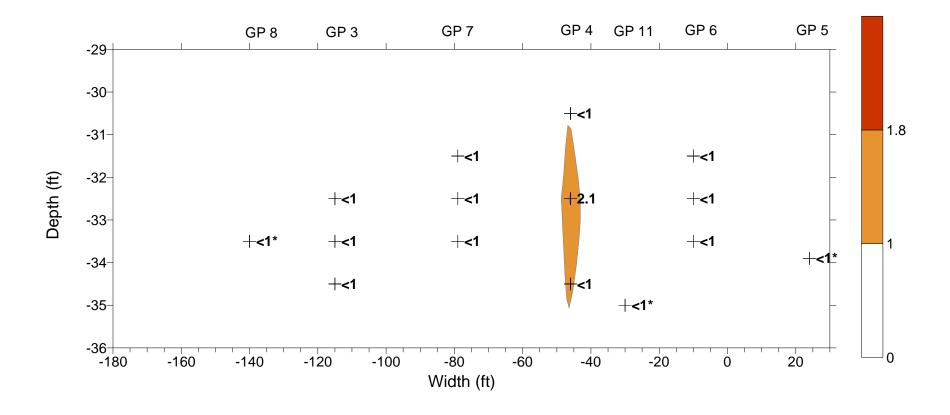


Figure 13. PCE Direct-Push Groundwater Concentrations (µg/L)

^{*} Composite sample of the open borehole

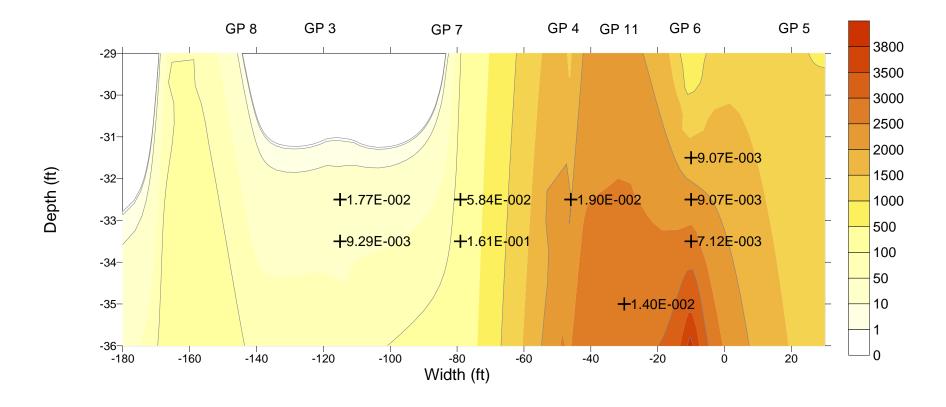


Figure 14. Hydraulic Conductivity Pneumatic Slug Test Data (cm/s) Overlain on TCE Contour Plot

^{*} Composite sample of the open borehole

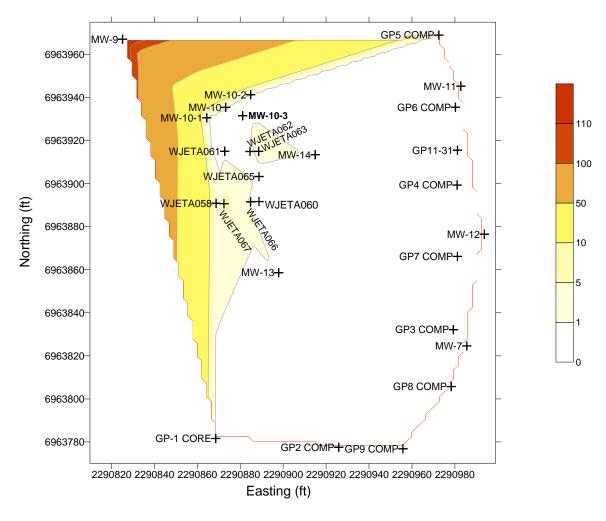


Figure 15. Aerial Contour Map of 1,1-DCE Groundwater Concentrations (µg/L) for Monitoring Wells and Composite Direct-Push Sampling Locations

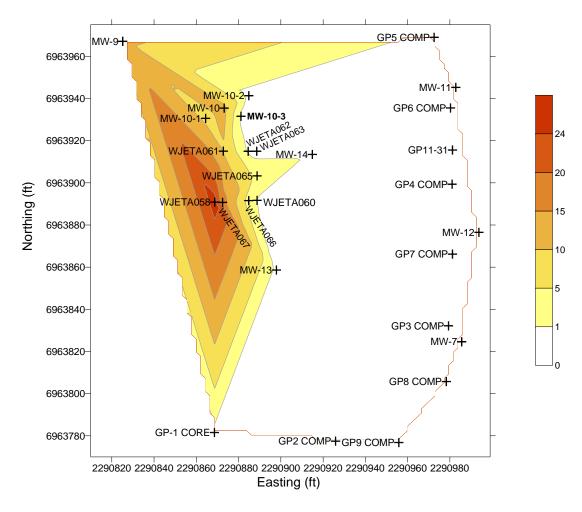


Figure 16. Aerial Contour Map of trans-1,2-DCE Groundwater Concentrations (μg/L) for Monitoring Wells and Composite Direct-Push Sampling Locations

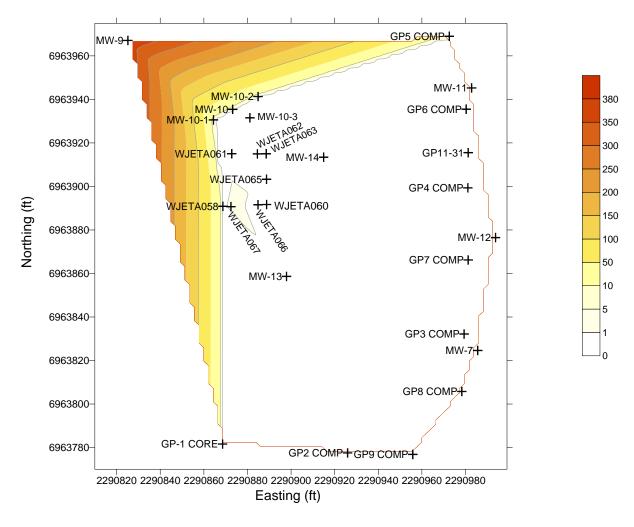


Figure 17. Aerial Contour Map of 1,1-DCA Groundwater Concentrations (µg/L) for Monitoring Wells and Composite Direct-Push Sampling Locations

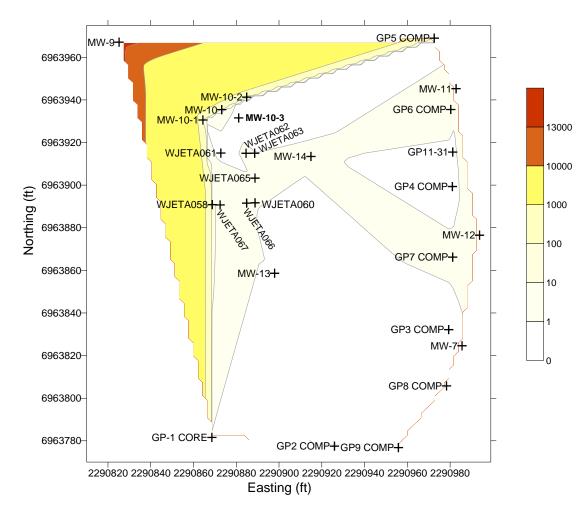


Figure 18. Aerial Contour Map of cis-1,2-DCE Groundwater Concentrations (µg/L) for Monitoring Wells and Composite Direct-Push Sampling Locations

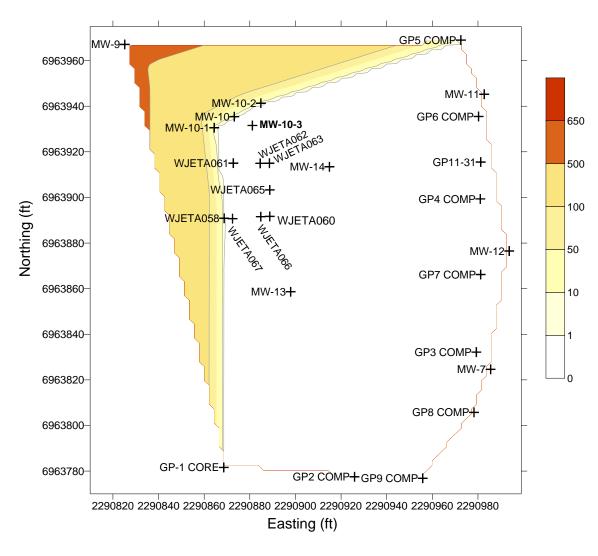


Figure 19. Aerial Contour Map of 1,2-DCA Groundwater Concentrations (μg/L) for Monitoring Wells and Composite Direct-Push Sampling Locations

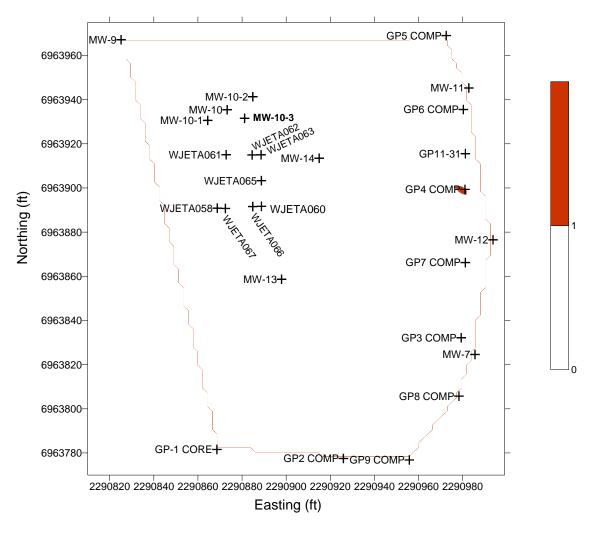


Figure 20. Aerial Contour Map of 1,1,1-TCA Groundwater Concentrations (µg/L) for Monitoring Wells and Composite Direct-Push Sampling Locations

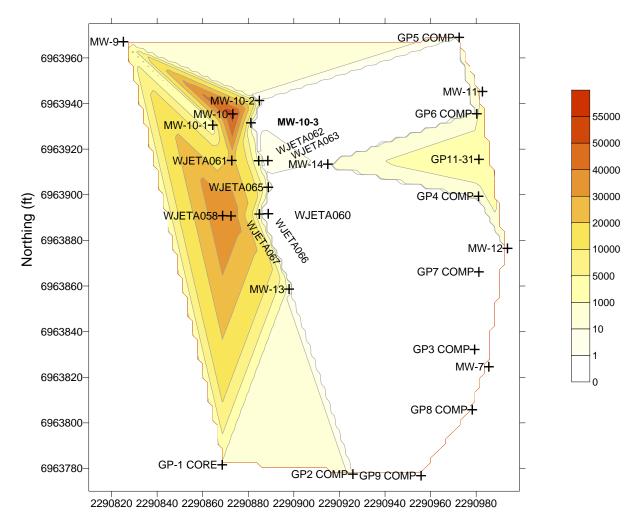


Figure 21. Aerial Contour Map of TCE Groundwater Concentrations (µg/L) for Monitoring Wells and Composite Direct-Push Sampling Locations

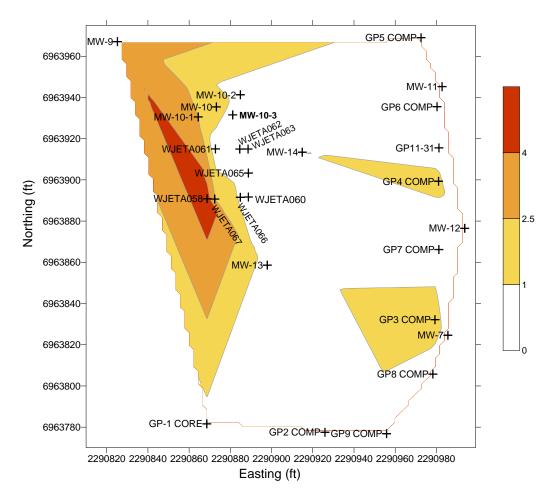


Figure 22. Aerial Contour Map of PCE Groundwater Concentrations ($\mu g/L$) for Monitoring Wells and Composite Direct-Push Sampling Locations

Tables

Table 1. Geologic Descriptions of Continuous Soil Cores (December 2006)

Boring Depth (ft)	Subsurface Features							
	Continuous Soil Core GP1							
26-31.5	Silty clay							
31.5-32.5	Silty sandy clay							
32.5-33.5	Silty sandy clay transitioning to limestone							
33.5-35	Limestone							
Continuous Soil Core GP3								
25-30.5	Silty clay							
30.5-33.5	Silty clay with gravels							
	Continuous Soil Core GP6							
25-26.5	Silty clay							
26.5-27.5	Silty clay with sands and gravels							
27.5-30.5	Silty clay							
30.5-33.5	Silty sandy clay transitioning to limestone							
33.5-34	Limestone							

Table 2. Sampling Locations and Types of Test Performed (December 2006)

Groundwater	Physica	al Assessment		Water Qualit	y Assessment
Monitoring Well or Direct-push Sampling Location	Depth-To-Water Measurement	Hydraulic Slug Test	Pneumatic Slug Test	Field Parameters ^d	Chlorinated Solvent Analysis
MW-7	Yes	Yes		Yes	Yes
MW-8 ^a	Yes				
MW-9	Yes	Yes		Yes	Yes
MW-10	Yes	Yes		Yes	Yes
MW-10-1					Yes
MW-10-2					Yes
MW-10-3					Yes
MW-11	Yes	Yes		Yes	Yes
MW-12	Yes	Yes		Yes	Yes
MW-13	Yes	Yes		Yes	Yes
MW-14	Yes	Yes		Yes	Yes
WJETA058	Yes			Yes	Yes
WJETA059	Yes				
WJETA060	Yes			Yes	Yes
WJETA061	Yes			Yes	Yes
WJETA062	Yes	Yes		Yes	Yes
WJETA063	Yes			Yes	Yes
WJETA064	Yes				
WJETA065	Yes			Yes	Yes
WJETA066	Yes			Yes	Yes
WJETA067	Yes	Yes		Yes	Yes
GP-1 ^b	Yes ^c				Yes
GP-2 ^b	Yes ^c			Yes	Yes
GP-3 ^b	Yes ^c			Yes	Yes
GP-4 ^b	Yes ^c		Yes	Yes	Yes
GP-5 ^b	Yes ^c		Yes		Yes
GP-6 ^b	Yes ^c			Yes	Yes
GP-7 ^b	Yes ^c		Yes	Yes	Yes
GP-8 ^b	Yes ^c		Yes	Yes	Yes
GP-9 ^b	Yes ^c				Yes
GP-10 ^b	Yes ^c				
GP-11 ^b	Yes ^c			Yes	Yes

^a Monitoring well was dry.

Water quality assessments and pneumatic slug testing at direct-push locations were performed on 1-ft intervals from the phreatic surface (~28' bgs) to the point of drilling refusal (33-35' bgs).

Depth to water measurements are approximate and not intended for groundwater elevation calculations. Field parameters include: pH, electrical conductivity, temperature, dissolved oxygen, and oxidation reduction potential.

Table 3. Slug Test Field Results (December 2006)

Monitoring Well	Well Screen (ft)	Hvorslev K (cm/s)	Hvorslev K (ft/d)	Bouwer and Rice K (cm/s)	Bouwer and Rice K (ft/d)
MW-7	19.5-34.5	1.64E-02	46.52	4.20E-02	119.02
MW-9	26-32	2.90E-05	0.08	5.07E-04	1.44
MW-10	28-34	4.30E-07	0.0012	1.12E-06	0.0032
MW-11	30-36	1.82E-03	5.16	4.19E-03	11.87
MW-12	28-34	9.68E-02	274.38	3.40E-01	962.37
MW-13	30-36	2.55E-02	72.26	9.80E-02	277.68
MW-14	29.5-35.5	6.54E-04	1.85	3.69E-03	10.46
WJETA062	25.2-29.7	6.04E-03	17.13	1.79E-03	5.07
WJETA067	25.5-30.5	6.47E-03	18.33	4.41E-04	1.25

Table 4. Depth-to-Groundwater Measurements for Monitoring Wells (December 2006)

Monitoring	Casing Diameter	Elevation from Top	NAD83 C	oordinates	Measured Total Depth	Measured Total Depth	DTW	DTW (ft	DTW (m	DTW	DTW
Well	(inches)	of Casing (ft MSL)	Northing	Easting	of MW (m BTOC)	of MW (ft BTOC)	(m BTOC)	BTOC)	BGS)	(ft BGS)	(ft MSL)
MW-7	4	655.46	6963825	2290986	9.37	30.74	8.87	29.09	9.03	29.63	626.37
MW-8	2	N/A	N/A	N/A	6.4	21.00	Dry	Dry	Dry	Dry	N/A
MW-9	2	654.9	6963967	2290825	9.31	30.54	5.81	19.07	6.00	19.68	635.83
MW-10	2	654.96	6963935	2290873			7.84	25.71	7.96	26.10	629.25
MW-10-1	2	654.94	6963931	2290864							N/A
MW-10-2	2	654.99	6963941	2290885							N/A
MW-10-3	2	655.27	6963932	2290881							N/A
MW-11	2	655.15	6963945	2290983	10.51	34.48	8.92	29.28	9.04	29.67	625.87
MW-12	2	655.11	6963876	2290994	9.83	32.25	8.91	29.24	9.06	29.72	625.87
MW-13	2	654.7	6963859	2290898	10.52	34.51	8.74	28.68	8.89	29.15	626.02
MW-14	2	655.02	6963913	2290915	10.4	34.12	8.86	29.07	8.93	29.30	625.95
WJETA058	4	654.99	6963891	2290869			8.61	28.23	8.85	29.05	626.76
WJETA059	4	655.06	6963915	2290869			8.74	28.68	8.90	29.20	626.38
WJETA060	4	655.07	6963892	2290889			8.75	28.69	8.78	28.80	626.38
WJETA061	4	655.04	6963915	2290873			8.72	28.62	8.86	29.05	626.42
WJETA062	4	655.11	6963915	2290885	9.23	30.28	8.77	28.77	8.88	29.13	626.34
WJETA063	4	655.14	6963915	2290889			8.81	28.92	8.89	29.18	626.22
WJETA064	4	655.01	6963903	2290868			8.61	28.25	8.84	28.99	626.76
WJETA065	4	655.11	6963903	2290889			8.70	28.54	8.89	29.15	626.57
WJETA066	4	655.07	6963892	2290885			8.69	28.52	8.87	29.11	626.55
WJETA067	4	655.03	6963891	2290872			8.75	28.69	8.86	29.07	626.34

DTW - Depth-to-water

BTOC - Below top of casing

BGS - Below ground surface

N/A - Data not available

MSL - mean sea level

--- No data available

NAD83 – North American Datum of 1983

Table 5. Water Quality Data for Monitoring Wells (December 2006)

Monitoring		,	Water Quality Data ^b		
Well	pН	EC (mS)	Temperature (°C)	DO (mg/L)	ORP (mV)
MW-7	6.9	0.79	21.6	5.7	249
MW-8 ^a					
MW-9	7.0	2.02	22.7	2.3	-24
MW-10	6.3	2.23	21.9	6.7	238
MW-10-1					
MW-10-2					
MW-10-3					
MW-11	7.0	0.61	23.7	6.0	202
MW-12	6.8	1.09	22.1	6.4	211
MW-13	7.1	0.48	22.6	7.4	208
MW-14	7.0	0.64	23.3	1.7	188
WJETA058	7.6	1.32	25.4	2.1	155
WJETA059					
WJETA060	7.1	0.68	22.7	4.7	191
WJETA061	7.5	1.39	25.4	1.3	157
WJETA062	7.6	0.68	25.2	2.1	168
WJETA063	7.8	0.50	23.9	<4	166
WJETA064					
WJETA065	7.5	1.34	24.7	1.6	173
WJETA066	7.82	1.33			159
WJETA067	7.6	1.35	24.8	<1	160

⁻⁻ indicates no water quality parameters were taken due to lack of water.

a Monitoring well was dry
b All measurements were made with a Horiba U-22 meter.

EC = electrical conductivity

D.O. = dissolved oxygen

ORP = oxidation-reduction potential

Table 6. Chemical Concentration Data for Monitoring Wells (December 2006)

	Date				Conc	entration (µg/L	<u>.)</u>				
Monitoring Well	Analyzed	Vinyl Chloride	1,1-DCE	trans-1,2-DCE	1,1-DCA	cis-1,2-DCE	1,2-DCA	1,1,1-TCA	TCE	1,1,2-TCA	PCE
MW-7	12.7.06	<1	<1	<1	ND <1	1	ND <1	<1	140	<1	<1
MW-9 (1)	12.7.06	<1	120	11	390	14000	670	<1	18000	<1	4
MW-9 (1) REP	12.7.06	<1	120	12	370	13000	610	<1	16000	<1	3
MW-9 (2)	12.8.06	<1	16	8	<1	7200	110	<1	13000	<1	3
MW-10	12.6.06	<1	<1	8	<1	<1	<1	<1	59000	<1	3
MW-10 DUP	12.8.06	1	2	10	<1	1	<1	<1	56000	<1	3
MW-10 (2)	12.12.06	<1	2	15	<1	4	<1	<1	58000	<1	1
MW-10-1	12.12.06	<1	1	9	<1	1	<1	<1	36000	<1	3
MW-10-2	12.12.06	<1	<1	<1	<1	<1	<1	<1	2500	<1	<1
MW-10-3	12.12.06	<1	<1	<1	<1	<1	<1	<1	3000	<1	<1
MW-11	12.7.06	<1	<1	<1	<1	2	<1	1	1800	<1	4
MW-11 DUP	12.12.06	<1	<1	<1	<1	<1	<1	<1	1700	<1	<1
MW-12	12.7.06	<1	<1	<1	<1	4	<1	<1	130	<1	<1
MW-13	12.6.06	<1	<1	<1	<1	<1	71	<1	1900	<1	<1
MW-13 REP	12.6.06	<1	<1	1	<1	<1	<1	<1	1900	<1	<1
MW-14	12.7.06	<1	1	1	<1	1	<1	<1	2200	<1	1
WJETA058	12.6.06	<1	2	26	<1	5	<1	<1	39000	<1	5
WJETA058 DUP	12.8.06	<1	2	17	<1	4	<1	<1	40000	<1	3
WJETA060	12.6.06	<1	1	1	<1	1	<1	<1	2500	<1	1
WJETA061	12.6.06	<1	<1	10	<1	<1	<1	<1	22000	<1	<1
WJETA061 DUP	12.8.06	<1	2	5	<1	8	1	<1	23000	<1	3
WJETA062	12.6.06	<1	<1	<1	<1	1	<1	<1	12000	<1	<1
WJETA062 DUP	12.8.06	<1	<1	2	2	1	<1	<1	12000	<1	1
WJETA063	12.7.06	<1	2	<1	<1	1	1	<1	6000	<1	<1
WJETA065	12.7.06	<1	<1	3	<1	1	<1	<1	16000	<1	<1
WJETA066 (1)	12.6.06	<1	3	3	1	3	2	<1	6000	<1	1
WJETA066 (2)	12.6.06	<1	<1	3	<1	2	<1	<1	7100	<1	1
WJETA067	12.6.06	<1	8	16	4	5	<1	<1	37000	<1	<1
WJETA067 DUP	12.7.06	<1	5	18	<1	7	1	<1	38000	<1	5

DUP - Duplicate sample
REP - Quality control sample (second analysis of same water sample)
TCA - Trichloroethane

DCE – Dichloroethene

DCA – Dichloroethane

TCE - Trichloroethene

PCE - Tetrachloroethene

Table 7. Survey Data for Direct-Push Downgradient Transect Locations

Sampling	Elevation from Ground Surface	NAD83 C	oordinates	Borehole Depth	Water Sample	WQ Data
Location	(ft MSL)	Northing	Easting	(ft BGS)	Collected	Collected
GP1 CORE	655.11	6963781.58	2290868.59	33.3	Yes	No
GP2 COMP	655.24	6963777.49	2290925.90	33	Yes	No
GP3 COMP	655.54	6963832.16	2290979.31	34	Yes	Yes
GP4 COMP	655.58	6963899.33	2290981.04	34.5	Yes	Yes
GP5 COMP	655.52	6963969.00	2290972.54	33.9	Yes	No
GP6 COMP	655.55	6963935.50	2290980.28	34.5	Yes	Yes
GP7 COMP	655.58	6963866.19	2290981.19	34.3	Yes	Yes
GP8 COMP	655.54	6963805.74	2290978.29	33.5	Yes	Yes
GP9 COMP	655.42	6963776.82	2290955.81	32.9	Yes	No
GP10 ^a	655.62	6964000.55	2290971.79	32.5	No	No
GP11-31/35	655.56	6963915.52	2290981.21	35	Yes	Yes

^a No water recovery in open borehole for water sampling BGS = below ground surface

MSL = Mean Sea Level

COMP = Composite Sample NAD83 = North American Datum of 1983

Table 8. Chemical Concentration Data for Direct-Push Downgradient Transect Locations (December 2006)

Sampling				Co	ncentration	(μg/L)				
Location	Vinyl Chloride	1,1-DCE	trans-1,2- DCE	1,1-DCA	cis-1,2- DCE	1,2-DCA	1,1,1-TCA	TCE	1,1,2-TCA	PCE
GP1 CORE	8	<1	<1	<1	1	<1	<1	220	<1	1
GP1 CORE (2)	6	<1	<1	<1	1	<1	49	230	<1	10
GP2 COMP	<1	<1	<1	<1	<1	<1	74	7	<1	<1
GP3 COMP	<1	<1	<1	<1	<1	<1	19	43	<1	4
GP3-32	5	<1	<1	<1	<1	<1	40	39	1	1
GP3-32 REP	4	<1	<1	<1	<1	<1	38	37	<1	1
GP3-33	<1	<1	<1	<1	1	<1	36	51	<1	<1
GP3-34	6	<1	<1	<1	<1	<1	30	40	<1	<1
GP3-34 DUP	4	<1	<1	<1	<1	<1	<1	39	<1	<1
GP4 COMP	<1	<1	<1	<1	<1	<1	1	4700	<1	1
GP4-30	<1	<1	<1	<1	<1	<1	<1	1500	<1	<1
GP4-32	<1	<1	<1	<1	1	<1	1	5400	<1	2
GP4-34	<1	1	<1	<1	1	<1	<1	2400	<1	1
GP5 COMP	<1	<1	<1	<1	<1	<1	<1	1100	<1	<1
GP5 COMP REP	<1	<1	<1	<1	<1	<1	<1	1300	<1	<1
GP6 COMP	<1	<1	<1	<1	2	<1	<1	710	<1	1
GP6-31	<1	<1	<1	<1	1	<1	100	560	<1	<1
GP6-32	<1	<1	<1	<1	13	<1	<1	2200	<1	<1
GP6-32 REP	<1	<1	<1	<1	<1	<1	<1	1300	<1	<1
GP6-33	<1	<1	<1	<1	1	<1	<1	3900	<1	1
GP7 COMP	5	<1	<1	<1	3	<1	<1	100	<1	<1
GP7-31	18	2	<1	<1	3	<1	<1	110	<1	<1
GP7-31 REDO	23	<1	<1	<1	3	<1	<1	16	<1	<1
GP7-32	<1	<1	<1	<1	1	<1	<1	52	<1	<1
GP7-33	<1	<1	<1	<1	1	<1	<1	39	<1	<1
GP7-33 DUP	<1	<1	<1	<1	1	<1	<1	37	1	<1
GP8 COMP	<1	<1	<1	<1	<1	<1	<1	33	<1	<1
GP9 COMP ^a	<1	<1	<1	<1	<1	<1	<1	5	<1	<1
GP11-31/35	<1	<1	<1	<1	1	<1	<1	2500	<1	1
GP11-31/35 DUP	<1	<1	<1	<1	<1	<1	<1	3300	1	1

^a Minimal groundwater recovery in borehole GP9. Distilled water was added to the borehole to provide enough water for sampling. Based on an estimated volume of groundwater in the borehole, distilled water was added to create a 1:10 dilution.

DUP = Duplicate sample, REP = Quality control sample (second analysis of same water sample), COMP = Composite sample of the open borehole DCE = Dichloroethene, DCA = Dichloroethane, TCE = Trichloroethene, TCA = Trichloroethane, PCE = Tetrachloroethene

Table 9. Water Quality Data for Direct-Push Downgradient Transect Locations (December 2006)

Sampling Location	Borehole Depth (ft BGS)	Water Sample Collected	WQ Data Collected	рН	EC (mS)	Temperature (°C)	DO (mg/L)	ORP (mV)
GP1 CORE	33.3	Yes	No					
GP1 CORE (2)	33.3	Yes	Yes	7.05	0.625	21		144
GP2 COMP	33	Yes	No					
GP3 COMP	34	Yes	Yes	6.76	0.806	22.4	5.28	151
GP3-32	32.5	Yes	Yes	6.86	0.97	21.7	6.88	51
GP3-33	33.5	Yes	Yes	6.98	0.832	22.5	4.13	78
GP3-34	34	Yes	No					
GP4 COMP	34.5	Yes	Yes	7.2	0.719	23.4	3.22	39
GP 4-30	30.5	Yes	No					
GP 4-32	32.5	Yes	Yes	7.13	0.739	23.6	1.95	44
GP4-34	34.5	Yes	No					
GP5 COMP	33.9	Yes	No					
GP6 COMP	34.5	Yes	Yes	7.06	0.587	24.4	6	94
GP6-31	31.5	Yes	No					
GP6-32	32.5	Yes	Yes	7.13	0.583	23.8	5.4	63
GP6-33	33.5	Yes	Yes	7.13	0.582	24	4.02	22
GP7 COMP	34.3	Yes	Yes	7	0.906	23.4	1.92	32
GP7-31	31.5	Yes	No					
GP7-32	32.5	Yes	Yes	6.85	1.03	23.4		70
GP7-33	33.5	Yes	Yes	6.83	1.03	23.6	6.15	57
GP8 COMP	33.5	Yes	Yes	6.95	0.784	23.5	4.65	181
GP9 COMP	32.9	Yes	No					
GP10 ^a	32.5	No	No					
GP11-31/35	35	Yes	Yes	5.7	0.606	25	8.32	191

⁻⁻ indicates no water quality parameters were taken due to lack of water.

NAD83 = North American Datum of 1983

EC = electrical conductivity

D.O. = dissolved oxygen

ORP = oxidation-reduction potential

BGS = below ground surface

COMP = composite sample

MSL = Mean Sea Level

^{(2) =} second sample from the same location

a No water recovery in open borehole for water sampling

b Measurements were made with a Horiba U-22 meter.

Table 10. Field Data Results for Pneumatic Slug Testing (December 2006)

Sampling Location*	Well Screen (ft)	Hvorslev K (cm/s)	Hvorslev K (ft/d)	Bouwer and Rice K (cm/s)	Bouwer and Rice K (ft/d)
GP3-32	32-32.5	6.25E-03	17.72	1.77E-02	50.13
GP3-33	33-33.5	3.31E-03	9.38	9.29E-03	26.35
GP4-32	32-32.5	2.81E-02	79.73	1.90E-02	53.96
GP6-31	31-31.5	4.33E-03	12.27	9.07E-03	25.72
GP6-32	32-32.5	1.61E-02	45.56	9.07E-03	25.72
GP6-33	33-33.5	4.47E-03	12.68	7.12E-03	20.18
GP7-32	32-32.5	1.00E-02	28.48	5.84E-02	165.54
GP7-33	33-33.5	5.98E-02	169.65	1.61E-01	457.66
GP11-31/35	31-35	8.57E-03	24.29	1.40E-02	39.76

Table 11. Monitoring Well Chemical Concentration Data Comparison

	V	inyl Chlor			1,1-DCE			rans-1,2-DC	E		cis-1,2-DC	E
Sample Location	ASU (Dec '06)	AFP4	1 Bldg. 181	ASU (Dec '06)	AFP4	Bldg. 181	ASU (Dec '06)	AFP4	4 Bldg. 181	ASU (Dec '06)	AFP4	Bldg. 181
	μg/L	μg/L	Date	μg/L	μg/L	Date	ug/L	ug/L	Date	ug/L	ug/L	Date
MW-7	<1	N/A	-	<1	N/A	-	<1	N/A	-	1	N/A	-
MW-9 (1)	120	N/A	-	120	N/A	-	11	N/A	-	14000	N/A	-
MW-9 (1) REP	120	N/A	-	120	N/A	-	12	N/A	-	13000	N/A	-
MW-9 (2)	16	N/A	-	16	N/A	-	8	N/A	-	7200	N/A	-
MW-10	<1	<130	Oct '04	<1	<130	Oct '04	8	28	Oct '04	<1	<130	Oct '04
MW-10 DUP	2	N/A	-	2	N/A	-	10	N/A	-	1	N/A	-
MW-10 (2)	2	N/A	-	2	N/A	-	15	N/A	-	4	N/A	=
MW-10-1 ^a	1	N/A	-	1	N/A	-	9	N/A	-	1	N/A	-
MW-10-2 ^a	<1	N/A	-	<1	N/A	1	<1	N/A	-	<1	N/A	-
MW-10-3 ^a	<1	N/A	-	<1	N/A	-	<1	N/A	-	<1	N/A	-
MW-11	<1	< 6.7	Oct '04	<1	<6.7	Oct '04	<1	< 6.7	Oct '04	2	4.9	Oct '04
MW-11 DUP	<1	N/A	ı	<1	N/A	ı	<1	N/A	-	<1	N/A	-
MW-12	<1	N/A	-	<1	N/A	-	<1	N/A	-	4	N/A	-
MW-13	<1	N/A	1	<1	N/A	ı	<1	N/A	-	<1	N/A	-
MW-13 REP	<1	N/A	ı	<1	N/A	ı	1	N/A	-	<1	N/A	-
MW-14	1	N/A	-	1	N/A	-	1	N/A	-	1	N/A	-
WJETA058	2	N/A	-	2	N/A	-	26	N/A	-	5	N/A	-
WJETA058 DUP	2	N/A	-	2	N/A	1	17	N/A	-	4	N/A	-
WJETA060	1	<10	May '03	1	<10	May '03	1	<10	May '03	1	<10	May '03
WJETA061	<1	<20	Oct '04	<1	<20	Oct '04	10	< 200	Oct '04	<1	4.7	Oct '04
WJETA061 DUP	2	N/A	ı	2	N/A	ı	5	N/A	-	8	N/A	-
WJETA062	<1	N/A	-	<1	N/A	ı	<1	N/A	-	1	N/A	-
WJETA062 DUP	<1	N/A	-	<1	N/A	ı	2	N/A	-	1	N/A	-
WJETA063	2	N/A	-	2	N/A	-	<1	N/A	-	1	N/A	-
WJETA065	<1	N/A	-	<1	N/A	-	3	N/A	-	1	N/A	-
WJETA066 (1)	3	N/A	1	3	N/A	ı	3	N/A	-	3	N/A	-
WJETA066 (2)	<1	N/A	-	<1	N/A	-	3	N/A	-	2	N/A	-
WJETA067	8	N/A	-	8	N/A		16	N/A	-	5	N/A	
WJETA067 DUP	5	N/A	-	5	N/A	ı	18	N/A	-	7	N/A	-

N/A – No Data Available, Dup – Duplicate Sample, REP – Quality Control Sample (second analysis of same sample), DCE – Dichloroethene, DCA – Dichloroethane, TCE – Trichloroethene, TCA – Trichloroethane, PCE - Tetrachloroethene, ND – Non-Detect (detection limit not available).

[&]quot;(1)" and "(2)" was used in the sample location nomenclature, by ASU, when more than one sample was collected from the same location.

The analytical results for 1,1-DCA and 1,1,2-TCA were not included in the comparison table, because historical data not available.

^a Monitoring wells were installed 2-weeks prior to the December 2006 field investigation, therefore historical analytical data was not available

Table 11. Monitoring Well Chemical Concentration Data Comparison Continued

		1,2-DCA			1,1,1-TC			TCE	1113011 CUI		PCE	
Sample Location	ASU (Dec '06)	AFP4	Bldg. 181	ASU (Dec '06)	AFP	4 Bldg. 181	ASU (Dec '06)	AFP4	Bldg. 181	ASU (Dec '06)	AFP4	Bldg. 181
	μg/L	μg/L	Date	μg/L	μg/L	Date	μg/L	μg/L	Date	μg/L	$\mu g/L$	Date
MW-7	<1	N/A	-	<1	N/A	-	140	72.5	Nov '02	<1	N/A	
MW-9 (1)	670	N/A	-	<1	N/A	-	18000	7280	Nov '02	4	N/A	-
MW-9 (1) REP	610	N/A	-	<1	N/A	-	16000	N/A	ı	3	N/A	-
MW-9 (2)	110	N/A	-	<1	N/A	-	13000	N/A	-	3	N/A	-
MW-10	<1	1200	Oct '04	<1	ND	Oct '04	59000	31000	Oct '04	3	<130	Oct '04
MW-10 DUP	<1	N/A	-	<1	N/A	-	56000	N/A	ı	3	N/A	-
MW-10 (2)	<1	N/A	-	<1	N/A	-	58000	N/A	-	1	N/A	-
MW-10-1 ^a	<1	N/A	-	<1	N/A	-	36000	N/A	-	3	N/A	-
MW-10-2 ^a	<1	N/A	-	<1	N/A	-	2500	N/A	ı	<1	N/A	-
MW-10-3 ^a	<1	N/A	-	<1	N/A	-	3000	N/A	-	<1	N/A	-
MW-11	<1	56	Oct '04	1	ND	Oct '04	1800	1600	Oct '04	4	<6.7	Oct '04
MW-11 DUP	<1	N/A	-	<1	N/A	-	1700	N/A	ı	<1	N/A	-
MW-12	<1	N/A	-	<1	N/A	-	130	93.9	Nov '02	<1	N/A	-
MW-13	71	N/A	-	<1	N/A	-	1900	756	Nov '02	<1	N/A	-
MW-13 REP	<1	N/A	-	<1	N/A	-	1900	N/A	-	<1	N/A	-
MW-14	<1	N/A	-	<1	N/A	-	2200	1620	Nov '02	1	N/A	-
WJETA058	<1	N/A	-	<1	N/A	-	39000	N/A	-	5	N/A	-
WJETA058 DUP	<1	N/A	-	<1	N/A	-	40000	N/A	-	3	N/A	-
WJETA060	<1	9.67	May '03	<1	ND	May '03	2500	4335	May '03	1	<10	May '03
WJETA061	<1	170	Oct '04	<1	ND	Oct '04	22000	4600	Oct '04	<1	<20	Oct '04
WJETA061 DUP	1	N/A	-	<1	N/A	-	23000	N/A	-	3	N/A	-
WJETA062	<1	N/A	-	<1	N/A	-	12000	1580	Nov '02	<1	N/A	-
WJETA062 DUP	<1	N/A	-	<1	N/A	-	12000	N/A	-	1	N/A	-
WJETA063	1	N/A	-	<1	N/A	-	6000	N/A	ı	<1	N/A	-
WJETA065	<1	N/A	-	<1	N/A	-	16000	2210	Nov '02	<1	N/A	-
WJETA066 (1)	2	N/A	-	<1	N/A	-	6000	1100	Nov '02	1	N/A	-
WJETA066 (2)	<1	N/A	-	<1	N/A	-	7100	N/A	-	1	N/A	-
WJETA067	<1	N/A	-	<1	N/A	-	37000	334	Nov '02	<1	N/A	-
WJETA067 DUP	1	N/A	-	<1	N/A	-	38000	N/A	-	5	N/A	

N/A – No Data Available, Dup – Duplicate Sample, REP – Quality Control Sample (second analysis of same sample), DCE – Dichloroethene, DCA – Dichloroethane, TCE – Trichloroethene, TCA – Trichloroethane, PCE - Tetrachloroethene, ND – Non-Detect (detection limit not available).

[&]quot;(1)" and "(2)" was used in the sample location nomenclature, by ASU, when more than one sample was collected from the same location.

The analytical results for 1,1-DCA and 1,1,2-TCA were not included in the comparison table, because historical data not available.

^a Monitoring wells were installed 2-weeks prior to the December 2006 field investigation, therefore historical analytical data was no

Table 12. Mass Flux Analysis for TCE

Hydraulic Conductivity Method	Sampling Locations Included	Discharge (kg/yr)
Bouwer and Rice Method	Discrete-depth Samples and Monitoring Wells	1.09E+01
Bouwer and Rice Method	Discrete-depth Samples only	4.92E+00
Horslev Method	Discrete-depth Samples and Monitoring Wells	5.55E+00
Horslev Method	Discrete-depth Samples only	4.57E+00

Draft

Site Specific Work Plan Former Pumphouse #2 Hunter Army Airfield (HAAF) Savannah, Georgia

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:
Arizona State University
Battelle

February 27, 2007

1.0 Site Description

Former Pumphouse #2 at Hunter Army Airfield (HAAF) is located in Savannah, Georgia, near former Building 8065, and lies along the east-west taxiway of HAAF (See **Figure 1**).

Former Pumphouse #2 was an aviation-gas fuel island that was used from 1953 until the early 1970s. The site consisted of ten 25,000-gallon (gal) underground storage tanks (USTs). The pumphouse was inactive from the 1970s to 1995 when eight of the 25,000-gal USTs were removed. Two 25,000-gal tanks remained in-place because they were partially under the pumphouse structure.

During previous investigations at the Former Pumphouse #2, petroleum contaminates were identified in the soil and groundwater, including benzene, toluene, ethylbenzene, and xylenes (BTEX), as well as polynuclear aromatic hydrocarbon (PAH) constituents. The extent of the plume was identified during these investigations to cover an area of approximately 85,800 square feet (ft²). The groundwater is migrating towards the drainage ditch, which is located to the east and south of the site. Previous investigations established that the groundwater plume had not migrated past the drainage ditch.

During the previous investigations, free product was identified. It was recommended that electrical resistance heating (ERH) be implemented to remove the free product, reduce the benzene concentration in groundwater below the alternate concentration limit (ACL) of 469 micrograms per liter (ug/L), and reduce the benzene and indeno (1,2,3-cd)pyrene concentrations in soil to below the proposed alternate threshold limits (ATLs) of 0.44 and 0.66 milligrams per kilogram (mg/kg), respectively.

Interim corrective actions consisted of free product recovery using absorbent socks. The free product in the wells increased, so product delineation piezometers were installed in 200 locations to determine the horizontal extent of the free product. The product covered an area of approximately 3,825 ft² (45 by 85 ft) around monitoring well, P2-MW27. In August 2001, the free product was shown to cover an area of 4,900 ft² and by the baseline sampling for the ERH application the free product covered an area of 11,500 ft².

The conceptual subsurface model for the Former Pumphouse #2 includes two aquifer systems. The lower aquifer is the principal artesian aquifer (Floridan) and it is approximately 800 ft in total thickness and is confined by a layer of phosphatic clay from the Hawthorn Group. This water is used primarily for drinking water. The second aquifer is the surficial aquifer, which was treated during the ERH.

The surficial aquifer overlies the Hawthorn confining unit and supplies water primarily for domestic lawn and agricultural irrigation. The top of the water table ranges from 9 to 16 ft bgs (specifically at Former Pumphouse #2). The groundwater in the surficial aquifer is typically unconfined with locally, thin clay beds creating confined and semiconfined conditions. The surficial aquifer at the Former Pumphouse #2 site's flow direction is driven by a nearby drainage ditch forcing groundwater to flow to the east and south into the drainage ditch.

2.0 System Description

A full-scale (completely covering the source area) ERH system was started in March 2002 and operated for four months. The system consisted of 111 electrodes at a spacing of 18 feet. The electrodes were spaced to treat and area of 30,000 ft², as seen in **Figure 2**. The electrodes were installed in unconsolidated material to a depth of 16 ft below ground surface (bgs) with the conductive interval set from 8 to 16 ft bgs. Eighteen of the electrodes were installed as a combination of electrode and dual vapor extraction (DVE) wells. Twenty-three vapor recovery wells (VRWs) were installed at a spacing of 40 ft. Additionally, 15 temporary piezometers were installed for groundwater samples. **Table 1** lists the screened intervals of the wells along with their diameter. After shutdown, the temporary piezometers were left in place and are still being sampled semi-annually.

3.0 Current Investigations

The available documentation for HAAF, Former Pumphouse #2 suggests that it is a good site for further investigation because:

- The hydrogeology of the site is reasonably well-characterized
- The aerial extent of the source zone was reasonably defined prior to treatment
- Full treatment of a source zone was performed
- The depth to groundwater is approximately 9 feet.
- The total depth of impacted groundwater is about 20 feet
- There is access to sampling locations immediately down-gradient of the remediated source zone
- The system employed at this site represents a state-of-the-art ERH system
- Pre- and post-treatment groundwater data are available
- Direct-push technologies can be used for sampling
- The monitoring well network is still present and accessible

Consistent with the already-approved generic demonstration plan for this project, the following site-specific activities are proposed:

- (5) Verification of the site geological conceptual model before any new investigative work by:
 - a. Measurement of depths to groundwater in nearby wells (to determine depth to groundwater, flow direction, and hydraulic gradient). See **Table 1** for monitoring well details and **Figure 3** for measurement locations.
 - b. Collection of one continuous soil core at the down-gradient edge of the treated source zone (to qualitatively confirm the site geology and to identify depths for subsequent groundwater vertical profile sampling). One or two additional cores will be collected if time permits. See **Figure 3** for sampling locations.
 - c. Slug tests or aquifer specific-capacity tests will be conducted in existing groundwater monitoring wells and temperature monitoring points in the area to get estimates of hydraulic conductivity over the screened intervals for those wells (to help identify if any zones are more conductive than others). See

Table 1 for details on the monitoring wells and **Figure 3** for measurement location. Aquifer specific-capacity tests will involve the measurement of the steady flow rate achieved with a fixed drawdown; ideally, all tests will be conducted with the same fixed drawdown (usually 0.3 - 1.0 feet)

- (6) Collection of data necessary to determine groundwater concentrations and fluxes leaving the treated source zone:
 - a. Groundwater samples collected from existing groundwater monitoring wells and temperature monitoring points with available historical data and analyzed for benzene, toluene, ethylbenzene, m-, p-, and o-xylene and naphthalene (BTEXN). See **Table 1** for details on the monitoring wells and **Figure 3** for their locations.
 - b. Groundwater samples will be collected using direct-push tools along a transect perpendicular to the direction of groundwater flow at the down-gradient edge of the original source zone. See Aquifer specific-capacity tests for groundwater sampling locations. Sampling locations will be approximately 60ft apart, and at each location samples will be collected, as possible, at least every 2 feet down to a maximum depth of 20 ft (and at least once in each distinct lithologic change suggested by the soil core). The samples will be analyzed via a headspace analysis on a gas chromatograph (GC) equipped with photo-ionization detector (PID) and flame-ionization (FID) detectors. If time permits, samples will be collected at additional locations as well. The specific depths and numbers of samples collected at each location may be adjusted depending on the analytical results in the field.
 - c. Aquifer specific-capacity tests will be conducted at each depth where a groundwater sample is collected. These tests will be conducted using the direct-push groundwater sampler and will involve the measurement of the steady flow rate achieved with a fixed drawdown; ideally, all tests will be conducted with the same fixed drawdown (usually 0.3 1.0 feet).

4.0 References

SAIC. 2005. "Sixth Semiannual Progress Report, Former Pumphouse #2, Facility ID #9-025086, Former Building 8065, Hunter Army Airfield, Georgia." November.

United States Environmental Protection Agency (EPA). 2005. "Cost and Performance Report: Electrical Resistive Heating at Former Pumphouse #2, Hunter Army Airfield, Georgia."

June.

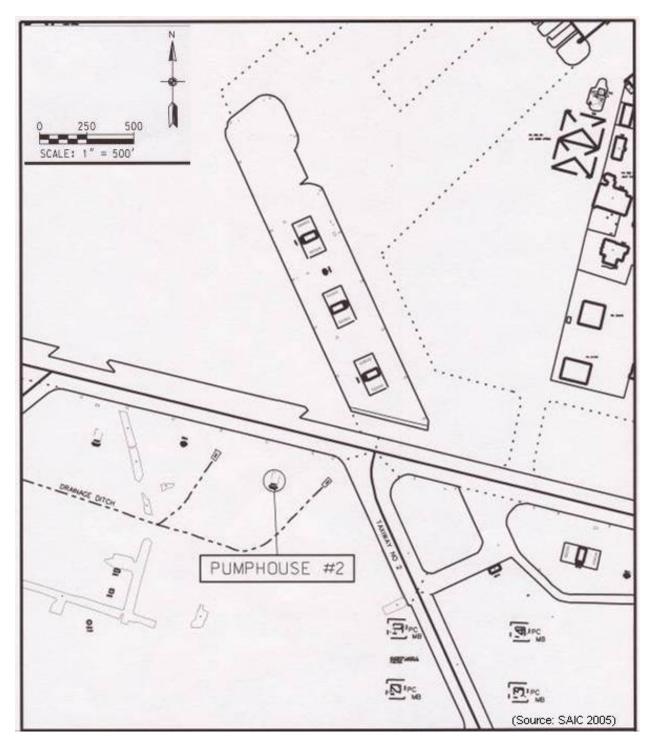


Figure 1. Site Map

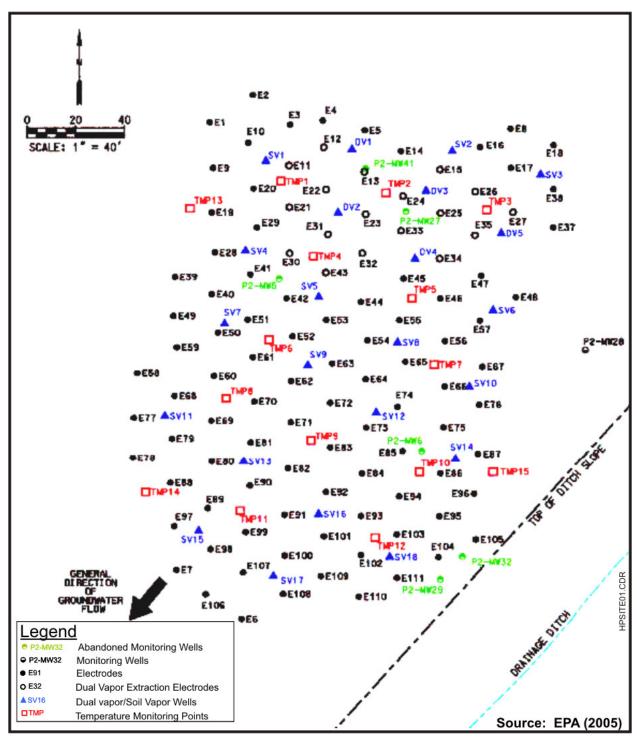


Figure 2. Electrical Resistance Heating Layout and Configuration

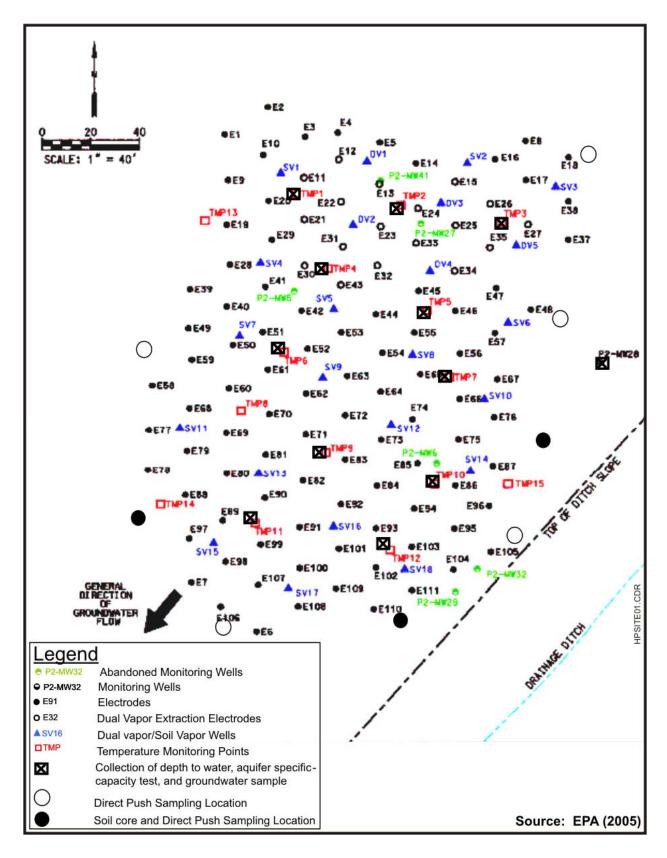


Figure 3. Sampling Locations

Table 1. Monitoring Well Details

Existing Monitoring Well	Screened Interval (ft bgs)	Well Diameter (in)	Water Level Measurement	Slug Test / Aquifer Specific- Capacity Test	Groundwater Sample
TMP-01	3-16	0.75	X	X	X
TMP-02	3-16	0.75	X	X	X
TMP-03	3-16	0.75	X	X	X
TMP-04R	4.8-14.8	N/A	X	X	X
TMP-05	3-16	0.75	X	X	X
TMP-07	3-16	0.75	X	X	X
TMP-09R	4.4-14	N/A	X	X	X
TMP-10	3-16	0.75	X	X	X
TMP-11	3-16	0.75	X	X	X
TMP-12	3-16	0.75	X	X	X
P2-MW28	3-16	0.75	X	X	X

N/A – Not Available

bgs – below ground surface

Health and Safety Plan (HASP) Former Pumphouse #2 Hunter Army Airfield (HAAF)

SECTION	SECTION 1: GENERAL INFORMATION AND DISCLAIMER				
CLIENT	LIENT NAME: Environmental Security Technology Certification Program (ESTCP) PROJECT NAME: ESTCP Thermal Evaluation				
PRINCIP	PRINCIPAL INVESTIGATORS: Eric Foote (Battelle) and Paul Johnson (Arizona State University)				
PROJECT	LEADER: P	aul Dahlen			
PREPAR	ED BY: Shan	• Williams	DATE: 03/12/2007		
NOTE:	IOTE: This Site Specific Health and Safety Plan - (HASP) has been prepared for use by Battelle employees for work at this site. Battelle is not responsible for its use by others. The plan is written for the specific LEVEL D site conditions, purposes, tasks, dates and personnel specified. If these conditions change, a new plan must be utilized and reviewed by those named in Section 17. Subcontractors shall be solely responsible for the health and safety of their employees and shall comply with all applicable laws and regulations. In accordance with 1910.120(b)(1)(iv) and (v), Battelle will inform its subcontractors of the site emergency response procedures, and any potential fire, explosion, health, safety or other hazards by making this Site Specific Safety and Health Plan and site information obtained by others available during regular business hours. All contractors and subcontractors are responsible for: (1)				
	programs req providing do laws and reg their own site	mired by federal, state and local laws and regu- cumentation that their employees have been hulations; (4) providing evidence of medical su	ritten Hazard Communication Program and any other lations; (2) providing their own personal protective e- salth and safety trained in accordance with applicable resillance and medical approvals for their employees that their employees comply with their own Health a activities.	quipment (PPE); (3) federal, state and local and (5) designating	
SECTION	V 2:	PROJECT INFORMATION			
(1)	SITE INFOR Site Name: Address	MATION Hunter Army Airfield Savannah, Georgia	Phone Number: 912-315- Site Safety & Health Contact: Shane W		
(2)	\(\) Haz: \(\) Com \(\) Lam \(\) UST \(\) Man \(\) Acti \(\) Inac \(\) Other	tive	(3) ENTRY OBJECTIVES (check or √ Site Inspection (General) √ Well Drilling Observatio □ Sampling, Air √ Sampling, Water √ Sampling, Soil □ Other: □ DATE(S) OF FIELD VISIT(S):		
(4)	B1. Grov B2. Grov B3. Wat	(ASU TASKS) undwater Investigation undwater sampling er level survey and sing tests lytical activities	TASK PERFORMED BY OTHERS 01. Direct pash activities for gw 02. IDW disposel 03. 04.	sample collection	
(5)	functions on PRINCIPAL SITE SAFET ALTERNAT PUBLIC INI SITE RECO: SITE PERSO FIELD TEA!	RGANIZATION AND COORDINATION - site. (Note: One person may carry out more investigators ry officer tive site safety officer(s) formation officer rd keeper onnel with cpr.fa M LEADER(s) LD TEAM MANAGERS	The following personnel are designated to carry out than one job function.) Eric Foote/Paul Johnson Shane Williams Jennifer Triplett/Paul Dahlen N/A Paul Dahlen/Jennifer Triplett Shane Williams Paul Dahlen Shane Williams	ne stated project job	

(6)	Shape	ON SITE CONTROL. Shape Williams has been designated to coordinate access control and security for Battelle operations on site. A safe perimeter has been established at the work area by delineating the work area with traffic comes and/or high-visibility barrier tape.								
	No un	No unauthorized person should be within this area.								
	The on	site Command	i Post and stagin	ig area	has been es	tablished at the pre-	rious ERH t	reatme	nt area.	
						ion indicator is used ice to prevent expo			y wind directions. The Command I se occur.	ost is located
			ave been establis ibility barrier tas		id include <u>s</u> e	outh and east of the	ERH test ar	wa. Th	ese boundaries are identified in the	field by: traffic
SECT	CTION 3: PHYSICAL HAZARDS									
(1)	IDEN:	MFY POTENT	IAL PHYSICA	L HAZ	ARDS TO	WORKERS (check	or circle al	l that a	pply)	
	•	Confined Sp	pace		Steep/Un	even Terrain		V	Drums Handling*	
	√	Heavy Equi		4	Heat Stre			ų.	Noise	
	V	Moving Par	ts	ò	Extreme	Cold		Ġ	Non-Ionizing Radiation	
		Heavy Lifti	ng		Ionizing l	Radiation			Other:	
		Electrical		4	Traffic					
	4	Overhead H	fazards		Biologica	l Hazards				
		Fall (>6; Ve	artical)		Surface V	Vater (Immersion)				
Site h	azards will t	be mitigated by	:							
١.	(1) Brinfin	a cita narranna	d as to identific	nhanie	d barreds m	ithin the work area.				
	(2) Identif	ying the "kill s	witch" on the dr	rilling r	rig.	igs, winter jackets,		donned	by site personnel.	
(2)	SAFE	TY EQUIPMEN	NT REQUIRED	FOR 1	BATTELLE	ASU EMPLOYE	ES (check o	circle	all that apply)	
		Explosimeter			Eye Wasi	1		Co	onfined Space Warning Signs	
	•	Fall Protection	on Equipment		Emergen	ry Shower	4		ommunications – On Site	
	4	Barrier Tape	Γape		Emergency Air Horn		4	Co	Communications - Off Site	
	4	Traffic Cone	Cones		Lights		0	Other:		
		□ Stretcher □			Lights - emergency		_			
				Ladder						
	√ A-B-C- Fire Extinguisher			☐ Tick Repellant						
	Smake Bite Kit					pe III)				
E		ment will be le	ested in the cab	of the					cation procedures. The field crew v	vill be senimed
			mergency air ho				M 12 101 COL		canna procedures. The next crew t	am oe equipped
SECT	ION 4:	CHEMICA	AL HAZARDS	INFOR	MATION					
(1)	IDEN:	TIFIED CONT.	AMINANTS							
	Known or a		rdous/toxic mate	arial (a	ttached histo	orical information, p	physical des	cription	n, map of contamination and tabula	ted
	Me	adia	Substance	s Invo	lved	Characte	ristics		Estimated Concentrations	PEL
	GW		BTEX (benze	ane, tol	uene.	VO and TO			Not Available	
			ethylbenzene.	, xylen	e).					
			Polycyclic ar	omatic						
			hydrocarbons		s)					
	SL		BTEX and P	AH's		VO and TO		_	Not Available	
			GW (ground	water).	SW (surfac	e water). WW (was	stewater). A	IR (air)), SL (soil), SD (sediments),	
	Media type	15							ite, gas) OT (other).	
	Characteris	sations				sive, caustic), IG (i UN (unknown), O			oactive), VO (volatile), TO (toxic),	
						of concern are attac ad signs and sympto			ets include information on the re.	

(2)	DESCRIBE POTENTIAL	FOR CONTACT WITH EACH MEDI	A TYPE FOR EACH OF THE BA	TTELLE/ASU TASKS LISTED IN SEC 2.4:
	BATTELLE TASK #	ROUTE OF EXPOSURE	POTENTIAL FOR CONTACT	METHOD OF CONTROL
	B 1	Inhal/Ingest/Contact/Absorb	High Medium Low	Level D PPE
	B2	Inhal/Ingest/Contact/Absorb	High Medium Low	Level D PPE
	B3	Inhal/Ingest/Contact/Absorb	High Medium Low	Level D PPE
	B4	Inhal/Ingest/Contact/Absorb	High Medium Low	Level D PPE
	The SSO will brief the field to chemical bazards.	team on interpretation of the attached M	ASDSs and particularly on sympton	ms and signs of over exposure
SECTI	ON 5: HAZARD COM	MUNICATION PROGRAM		
	etc.), bring a copy of the Ba	to the site by Battelle/ASU (e.g., decoratelle Hazardous Communication Progersonnel. The current list of chemicals	ram and associate MSDSs to the si	
	BTEX		Alcohol	
	PAHs		Liquinox®	
	HCL (preservative)			
SECTI	ON 6: ENVIRONMEN	ITAL MONITORING		
(1)	The following environment	al monitoring instruments shall be used	d on site at the specified intervals f	or breathing zone monitoring:
	EQUIPMENT	MONITORING PERIOD		ACTION LEVEL
	Combustible Gas Indicator	daily/hourly/continuous/other		
•	O2 Meter	daily/hourly/continuous/other		
4	PID (Lamp10.6_eV)	daily/ hourly/continuous/othe s		
•	FID	daily/hourly/continuous/other		
0	Radiation Meter (Gamma)	daily/hourly/continuous/other		
	Respirable Dust Meter GC/FCD/FID	daily/hourly/continuous/other		- <u>- </u>
J	GC/FID/PID/DELCD	daily/hourly/continuous/other daily/ hourly/continuous/other		- <u>- </u>
٧.	GC/FID/FID/DELCD	daily/hourly/continuous/other		· —
		daily golling continuous occu-	·	· —
(2)		be calibrated according to the manufactorization in the Health and Safety on-		and after each day of use. Record
(3)		tdown and excavation. These are aver- pounds from the waste or from reaction Vs.		
				ACTION LEVEL
	Uncharacterized Airborne Characterized Airborne G Oxygen Flammability		>50 < 1	nckground 196 PEL, REL, TLV 9.5; >23.5 0% LEL
(4)	safety kick-off meeting of s described above or if discer representative will be notifi	sonnel in charge of buildings adjacent to the activities. A copy of this HASP with mible odors are released as a result of fined immediately. Perimeter monitoring panic vapors or odors are leaving the	ll be provided. If any action levels ield activities, the personnel in cha ag (support zone) will be conduct	are reached at the work area as rge or their designated

SECTION 7:	HEALTH AND SAFETY TR	AINING/MI	EDICAL MONITORING	PROGRAM		
The project staff is in	actuded in the Battelle Health an	d Safety Tr	aining and Medical Monit	toring Progra	ms in conformance w	ith 29 CFR 1910 R.
			HAZW	OPPER TRA	INING	
NAME	MEDICAL		INITIAL		REFRESHER	CPR/FA/
	(Date)		(Hrs/Date)		(Date)	(Dates)
Eric Foote	August 2006		40 hours/ 1992	Jt	ше 2006	May 2004
						(good for 3 years)
Shane Williams	February 2006		40 hours/April 1994		ıly 14, 2006	July 2006
					-, -,	(good for 3 years)
Jennifer Triplett		_	40 hours/June 2001		ugust 7, 2005	(80000000000000000000000000000000000000
Paul Dahlen	_	_	40 hours/Nov 1992		ebruary, 2006	
		_				
Paul Johnson	_	_	40 hours/ 1987	^	ngust 12, 2005	
SECTION 8:	PERSONAL MONITORING					
4	No personal exposure monitor anticipated, this HASP will be			ll take place o	m site. If the need for	such monitoring is
SECTION 9:	CONFINED SPACE ENTRY					
4	No confined space and/or tren this HASP will be modified ac		ill take place on site. If th	be possibility	of such entries taking	place exists,
SECTION 10:	COMMUNICATION PROCE	DURES				
The follow	wing standard hand signals will	ha maad in c	are of failure to radio con	amonications	in each contaminant	reduction zone:
120 10110	wing standard name signars with	oe men in c	ase of familie to famile con	ummuncations.	ID VACE COMMEMBER.	educada zone.
Hand 9	gripping throat		-	Can't Talk	, Having difficulty be	eathing
Grip p	Grip partner's wrist and both hands around wrist — Can't Talk, Leave area immediately					
Hands	Hands on top of head – Need assistance					
Thumb	Thumbs up - OK, I am all right, I understand					
Thumb	Thumbs down - No, negative					
mobile ph	If applicable, telephone communications to the Command Post Should be Established as soon as possible. The stationary and/or mobile phone number(s) will be available one week prior to the start of field work. The HASP will be amended when these numbers are available.					
The comm	and post telephone is 480-5	16-1422				
The mobile	phone is 480-516-1422					
SECTION 11:	DECONTAMINATION PRO	CEDURES				
the comm	and equipment leaving an exch and post. The SSO is responsib ination protocol shall be used w	le for monit	oring adherence with this	decontamina		
(1) E	quipment Drop (IF NECESSAR	Y)				
	oot Covers, and Glove Wash an		MECESSARV)			
	uter Boot and Glove Removal (AKI)			
	outer Garment Removal (IF NEC					
	nner Glove Removal (IF NECES ield Hand Wash	SAKI)				
, .						
The follo	wing decontamination equipmen	it is required	d (check or circle all that	apply)		
	econ Pad (Plastic Sheet)	•	Dry Brashes	√	Detergent Scap	
	rash Cans/Bags	√	Wet Brushes	•	Other Decontamin:	stion Solution
√ E	Buckets	√	Water			
						_

ER-0314 181 Appendix D

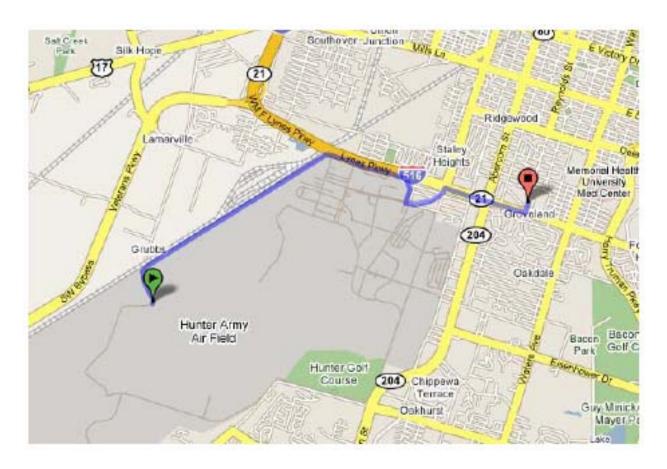
EMERGENCY PROCEDURES On site personnel will use the following standard emergency procedures. The SSO shall be notified of any on site emergencies and be responsible for ensuring that the procedures are followed. DESIGNATED EMERGENCY SIGNAL: Air Horn Upon notification of an injury in the Exclusion Zone, the designated emergency signal shall be sounded. All site personnel shall assemble at the decontamination line. The SSO or alternate should evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the Support Zone. The on site CPR/FA personnel shall initiate the appropriate first aid, and contact should be made for an ambulance (and other emergency services as needed) and with the designated medical facility (if required). No persons shall reenter the Exclusion Zone until the cause of the injury or symptoms are determined. DESIGNATED EMERGENCY SIGNAL: Air Horn Fire/Explosion Upon notification of a fire or explosion on site, the designated emergency signal shall be sounded and all site personnel assembled at the decontamination line. The fire department shall be alerted and all personnel moved to a safe distance from the involved area. Equipment Failure If any other equipment (i.e., air monitoring) on site fails to operate properly, the Field Team Leader and SSO shall be notified and then determine the effect of this failure on continuing operations on site. If the failure affects the safety of personnel or prevents completion of the Work Plan tasks, all personnel shall leave the Exclusion Zone until the situation is evaluated and appropriate actions taken. Emergency escape routes are designated for use in those situations where egress from the Exclusion Zone cannot occur through the decontamination line In all situations, when an on site emergency results in evacuation of the Exclusion Zone, personnel shall not reenter until: The conditions resulting in the emergency have been corrected. The hazards have been reassessed by the SSO. The Site Safety Plan has been reviewed by the SSO and Corporate Health and Safety Manager. SECTION 13: SPILL CONTROL PROCEDURES No containers of liquid or solids exist on site and no spill control plan is necessary. If the possibility of such conditions exists on site, this HASP will be modified accordingly. SECTION 14: EMERGENCY INFORMATION (1) LOCAL RESOURCES Ambulance (name): **Emergency Services** Phone: 911 St. Joseph/ Candler Hospital Hospital (name): 911 or (912) 819-6000 Phone: Police (local or state): Savannah Police Department 911 or (912) 232-4141 Phone: Fire (name): Savannah Fire & Emergency Phone: 911 or (912) 651-6758 Services 911 or (912) 651-6758 HAZ MAT Responder: Savannah Special Operations Phone: Division 614-348-4437 On-Site CPR/FA(s): Shane Williams Phone: For life-threatening emergencies or emergency trauma care. The above hospital is approximately 4.8 miles from the furthest work area and the ambulance response time is approximately 13 minutes. ** For non-life threatening medical care. The above hospital is approximately 13 minutes from the furthest work area. Injured workers will be transported here for non-emergency treatment (2) DIRECTIONS TO NEAREST HOSPITAL – SEE ATTACHED MAP: Figure 1. (3) BATTELLE RESOURCES Health and Safety Representative (BSTI) Site Contact: Eric Foote: 614-374-2729 Stephanie Helgerman, CSP, 614-424-7363

Battelle Security Office (614) 424-4444

SECTION 15: PERSONAL PROTECTIVE EQUIPMENT (check or circle all that apply)							
4	No type of respiratory protection is required on this site. If the possibility of the need for respiratory protection is anticipated, this HASP will be modified accordingly.						
CLOTHIN	G		GLOVES		BOOTS		OTHER
□ Coveralls □ Tyvek			otton eather	4	Safety Fireman/Hip	4	Hard Hat Safety Glasses (with side shields)
□ Saranex □ PE Tyyek		,	litrile	_	Neoprene Steel Toe	0	Goggles
□ PE Tyvek □ Other:			Butyl Veoprene	4	Steel 10e	√	Face Shield Hearing Protection
			liton VC				
			VA.				
	_	о I	atex				
Smoki Ignitic Ignitic Conta De no If drill All ele (GFC) A "Bu	THE FOLLOWING PRACTICES MUST BE FOLLOWED BY PERSONNEL ON SITE 1. Smoking, eating, chewing gum or tobacto, or drinking are forbidden except in clean or designated areas. 2. Ignition of flammable liquids within or through improvised heating devices (e.g., barrels) is forbidden. 3. Contact with samples, excavated materials, or other contaminated materials must be minimized. 4. Do not kneel on the ground when collecting samples. 5. If drilling equipment is involved, know where the kill switch is. 6. All electrical equipment used in outside locations, wet areas, or near water must be plugged into ground fault circuit interrupter (GFCI) protected outlets.						
8. Good 1 9. Where	housekeeping practices a	re to be	maintained. d to corrosive materials, w	ator onital	ale for ouick drawe	hing or flushi	ing chall he available
	mediate use.	expose	d to corrosive materials, w	ater suitat	ne for quica areas	aing or mism	ing small de avalladie
10. In the	event of treacherous wes ook will be enemended on	ther-rela til condit	sted working conditions (i. tions improve or appropris	e., thunder to protecti	rstorm, limited visi ion from the eleme	ibility, extres exts is provide	ne cold or heat) the
SECTION 17:	EMPLOYEE ACKNO						
PLAN REVIEW	ED BY:						DATE
H&S Represent			Helgerman, CSP			_	
Principal Invest Project Leader:	incipal Investigator Eric Foote; Paul Johnson oject Leader: Paul Dahlen						
Site Safety Offi	_	hane Wi				_	
	ledge that I have read the to comply with the cont		ation in this HASP form as he plan.	id the atta	ched MSDSs. I un	iderstand the	site hazards as described
FIELD PE	RSONNEL (Print Name))	SIGNAT	URE			DATE
		_					
		_					
		_					
VISI	TOR (Print Name)	_	SIGNAT	URE			DATE
Organizatio	n/Agency	_					
Organizatio	n/Agency	_					

ER-0314 183 Appendix D

Figure 1



From: Hunter Army Airfield

Drive: 4.8 miles (about 13 minutes) to St. Joseph's/Candler Hospital

- 1) Head northeast on S Perimeter Road toward Stephen Douglas Street: 3.5 mi.
- 2) Turn left at Duncan Drive: 190 ft.
- 3) Continue on Montgomery Street: 0.4 mi.
- 4) Turn right at W. Derenne Avenue/ GA-21 S: 0.8 mi.
- 5) Turn left at Reynolds Street: 486 ft.

Arrive: St. Joseph/Candler Hospital, 5356 Reynolds St., Savannah, GA 31419

Draft Final

Data Analysis Report of Hunter Army Airfield – Former Pumphouse #2

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:

Arizona State University Battelle

June 2007

The vendors and products, including the equipment, system components, and other materials identified in this report, are primarily for information purposes only. Although some of these vendors and products may have been used in the past, mention in this report does not constitute a recommendation for using these vendors or products.

Contents

FIGURES	
TABLES	
ACRONYM	IS AND ABBREVIATIONS 189
1. INTROD	DUCTION
2. FIELD I	NVESTIGATION
3. REFERE	ENCES 193
	Figures
Figure 1. Figure 2. Figure 3. Figure 4.	Site Map Direct Push Locations Hydraulic Conductivity Measurement Locations Monitoring Well Depth-to-Water Measurements and Groundwater Sampling Locations
Figure 5. Figure 6. Figure 7. Figure 8.	Interpolated Groundwater Elevation Map Cross-section of Direct Push Sampling Locations Electrical Conductivity Results Benzene Direct-Push Groundwater Concentrations (µg/L)
Figure 9. Figure 10. Figure 11. Figure 12.	Toluene Direct-Push Groundwater Concentrations (μg/L) Ethylbenzene Direct-Push Groundwater Concentrations (μg/L) m/p-Xylene Direct-Push Groundwater Concentrations (μg/L) o-Xylene Direct-Push Groundwater Concentrations (μg/L)
Figure 13. Figure 14. Figure 15. Figure 16.	Naphthalene Direct-Push Groundwater Concentrations (µg/L) Hydraulic Conductivity Test Data (cm/s) Overlain on Benzene Contour Plot Benzene Contour Plot Toluene Contour Plot
Figure 17. Figure 18. Figure 19. Figure 20.	Ethylbenzene Contour Plot m/p Xylenes Contour Plot o Xylenes Contour Plot Naphthalene Contour Plot

Figure 21. Mass Flux Analysis of Benzene Data Figure 22. Interpolated Benzene Concentration Grid Interpolated Hydraulic Conductivity Grid Figure 23. Figure 24. Benzene Mass Flux Results **Tables** Table 1. Geologic Descriptions of Continuous Soil Cores Table 2. Sampling Locations and Types of Test Performed Table 3. Slug Test Results Field Data and Results for Constant Drawdown Aquifer Testing in Monitoring Wells Table 4. Table 5. Depth-to-Groundwater and Groundwater Elevations for Monitoring Wells Table 6. Water Quality Data for Monitoring Wells Table 7. Chemical Concentration Data for Monitoring Wells Table 8. Chemical Concentration Data for Direct Push Downgradient Transect Locations

Water Quality Data for Direct Push Downgradient Transect Locations

Table 10. Field Data and Results for Constant Drawdown Aquifer Testing in Direct-Push

Table 11. Monitoring Well Chemical Concentration Data Comparison

Downgradient Transect Locations

Table 9.

Acronyms and Abbreviations

bgs below ground surface

DO dissolved oxygen

EC electrical conductivity
ERH electrical resistance heating

ESTCP Environmental Security Technology Certification Program

FID flame-ionization detector

ft feet

GC gas chromatography

kg kilogram

ORP oxidation reduction potential

PID photo-ionization detector

temp temperature

VOA volatile organic analysis

yr year

1. Introduction

The post-treatment field investigation of Hunter Army Airfield – Former Pumphouse #2, under the Environmental Security Technology Certification Program (ESTCP) project ER-0314, *Critical Evaluation of State of the In-Situ Thermal Treatment Technologies*, was performed March 26 through April 2, 2007. Figure 1 is a site map that identifies the extent of the previous electrical resistance heating (ERH) remediation area, which was also the specific area of interest for this particular field investigation.

Consistent with the objectives set forth under the ER-0314 Demonstration Plan, the field investigation at this site included the following:

Verification of the site hydrogeological conceptual model

Groundwater sampling of monitoring wells

Depth-discrete analysis of hydraulic conductivity and dissolved petroleum hydrocarbons at temporary sampling locations downgradient of the treatment zone.

2. Field Investigations

In accordance with the approved generic demonstration plan for this project, the following sitespecific activities were conducted:

- (6) Verification of the site hydrogeological conceptual model:
 - c. For confirmation of geology, two continuous soil cores were collected at direct-push sampling locations GP3 and GP6 shown in Figure 2. The continuous soil cores/ direct-push sampling locations were located at the down-gradient edge of the treatment zone. Table 1 presents qualitative geologic descriptions from visual observations of the two continuous soil cores
 - d. Hydraulic conductivity slug testing was conducted in monitoring well, P2-MW28 identified in Table 2 and in Figure 3. The slug test data were analyzed using both the Hvorslev and the Bouwer and Rice Methods; results are presented in Table 3. The Hvorslev' expression for determining hydraulic conductivity from slug test data is:

$$K = (r^2 \ln(L_e/R))/(2L_e t_{37})$$

Where K = hydraulic conductivity (L/T) r = radius of well casing (L) (0.083 ft) R = radius of well screen (L) (0.50 ft)

L_e = length of well screen (L) (10 ft or the saturated thickness if well screen was not completely covered)
t₃₇ = time for water level to rise or fall 37% of the initial change
(T) (from data set)

(Fetter, 2000).

The Bouwer and Rice expression for determining hydraulic conductivity from slug test data is:

$$K=(r_c^2 ln(R_e/R) / (2L_e)) * ((1/t) ln(H_o/H_t))$$

Where K = hydraulic conductivity (L/T)

 r_c = radius of well casing (L) (0.083 ft)

R = radius of gravel envelope (L) (0.50 ft)

R_e = effective radial distance over which head is dissipated (L) (from data set)

L_e = length of well screen (L) (10 ft or the saturated thickness if well screen was not completely covered)

 $H_0 = drawdown at t=0 (L) (from data set)$

 $H_t = drawdown at t=t (L) (from data set)$

 $t = time since H = H_0 (T) (from data set)$

(Fetter, 2000).

In addition, aquifer specific-capacity tests were conducted on 11 monitoring wells, which were unsuitable for performing slug tests. Nine (9) of the eleven (11) monitoring wells were unsuitable due to insufficient casing diameter (1-inch). The remaining two (2) monitoring wells had sufficient casing diameters (2-inch), however the water column measured in the wells were of insufficient depth for performing slug tests. Specific-capacity tests involve measurements of the flow rate achieved under fixed drawdown and are analyzed using the Theim Equation to estimate hydraulic conductivity. The results are presented in Table 4. The Theim equation for hydraulic conductivity is:

$$T = (Q/(2(h_2-h_1))* ln(r_2/r_1)$$

Where $T = transmissivity (L^2/T)$

 $Q = pumping rate (L^3/T)$

 h_1 = head at distance r_1 from the pumping well (L)

 h_2 = head at distance r_2 from the pumping well (L)

$$K = T/b$$

Where K = hydraulic conductivity (L/T)

b = length of sampler or screen section (L) (0.5 ft or length of screen) (Fetter, 2000).

- e. Depth-to-groundwater was measured in the 12 groundwater monitoring wells identified in Table 2 and in Figure 4. Depth-to-water measurements, groundwater elevations, and survey coordinates are summarized in Table 5. An interpolated groundwater elevation map is presented in Figure 5.
- (7) Collection of water quality samples from 11 groundwater monitoring wells within the treatment zone and one monitoring well cross-gradient of the treatment zone for analysis of dissolved petroleum hydrocarbon groundwater concentrations:

- f. Table 2 identifies the groundwater monitoring wells from which samples were collected. Prior to sample collection, three well-volumes were purged. Groundwater was then collected for analysis of field parameters and stored in volatile organic analysis (VOA) vials for analysis of dissolved petroleum hydrocarbon concentrations. General water quality field parameters including pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP) were measured using an Horiba U-22 meter. Petroleum hydrocarbon analysis was performed on-site by heated-headspace analysis and gas chromatography (GC) using a photo-ionization detector (PID) and a flame-ionization detector (FID). General water quality data for permanent groundwater monitoring well installations can be found in Table 6 and chemical concentration data can be found in Table 7. All non-detect samples are listed as less than the detection limit.
- (8) Depth-discrete hydraulic conductivity and dissolved petroleum hydrocarbon concentration data were collected on one or two foot intervals as possible from 12 ft below ground surface (bgs) to ~22 ft bgs at all 10 direct-push sampling locations.
 - g. Groundwater quality data were collected from depth-specific intervals at all direct-push sampling locations (See Table 2 and Figure 2). Sampling locations were spaced on approximately 50 ft centers, as possible, along a transect downgradient of the source zone and perpendicular to the direction of groundwater flow. Figure 2 presents the direct-push sampling locations. Sample locations were placed around the treatment zone because previous work by others suggested the drainage ditch surrounding the site caused radial flow and dissolved petroleum hydrocarbon migration could be radially outward. Using percussion assisted direct-push technology and a modified Geoprobe Groundwater Profiler. groundwater samples were collected using a peristaltic pump on 2-ft intervals from 13 ft bgs to ~22 ft bgs. The location of the depth-discrete groundwater samples are shown in Figure 6. Dissolved petroleum hydrocarbon concentration analysis was conducted, as described above, and the results are summarized in Table 8. General water quality parameters (e.g. pH, EC, temp, DO, and ORP) were also collected during depth-specific sampling, and those data are presented in Table 9.
 - h. Aquifer specific-capacity tests were conducted at depth-specific intervals at all direct push sampling locations, as indicated in Table 2. Specific-capacity tests involve the measurement of the flow rate achieved under fixed drawdown and are analyzed using the Theim Equation to estimate hydraulic conductivity. The field data and results for aquifer testing are shown in Table 10.

Additional field work included soil conductivity measurements at GP3 and GP6 using a Geoprobe Direct Image Electrical Conductivity Probe (Wenner array). Results of the soil conductivity tests are shown in Figure 7.

The monitoring well chemical concentration data collected in March/April 2007 by the ASU/Battelle team were compared to the previous monitoring well chemical concentration data available for the site. The analytical results for each are shown in Table 11.

Figures 8 through 13 show vertical chemical concentration contour plots in a transect perpendicular to the dominant groundwater flow direction for seven analytes measured in depth-discrete direct-push samples. Figure 14 presents the hydraulic conductivity data from the aquifer specific-capacity tests for each depth-discrete direct-push sampling interval overlaid on the Benzene chemical concentration contour plot.

Plan view contour plots of the chemical concentrations for the analytes (benzene, toluene, ethylbenzene, m/p-xylene, o-xylene, and naphthalene) are shown in Figures 15 through 20. These contour plots were constructed using the concentration data from 11 monitoring wells and the highest discrete-depth concentration from each direct-push sampling location. Using the benzene groundwater concentration data, the hydraulic conductivity estimates (Table 10) calculated from the depth-discrete direct-push sampling and an average calculated gradient, a benzene mass flux calculation was performed using the Mass Flux Toolkit, Version 1.0. The average gradient of 0.01 ft/ft was chosen because each individual direct-push sampling location had a hydraulic gradient of approximately 0.01 ft/ft based on an extrapolated groundwater elevation map. The groundwater elevation map was used because the treatment zone had a surface elevation that varied significantly and the depth-to-water measurements were thus, unusable because no survey data was available for the temporary sampling locations. The Mass Flux Toolkit is a freeware program developed by Groundwater Services, Inc. and others under a contract funded by ESTCP. Figure 21 is a snapshot of the Benzene inputs used to perform the mass flux analysis. Linear spatial and vertical interpolation of the concentration, hydraulic conductivity, hydraulic gradient, and mass flux data were used for the analysis. Figures 22 and 23 show the interpolated concentration grid and the interpolated hydraulic conductivity grid, respectively. Finally, Figure 24 shows the mass flux result for Benzene, which is estimated to be 3.75E-02 kg/yr.

3. References

Fetter, C.W. 2000. Applied Hydrogeology. 4th ed. Upper Saddle River, New Jersey: Prentice-Hall. pp.197-200.

Figures

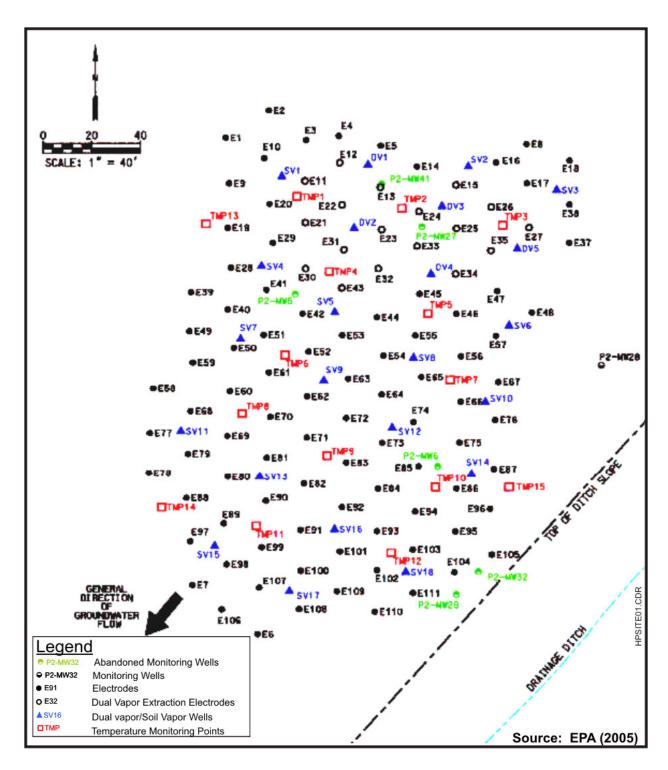


Figure 1. Site Map

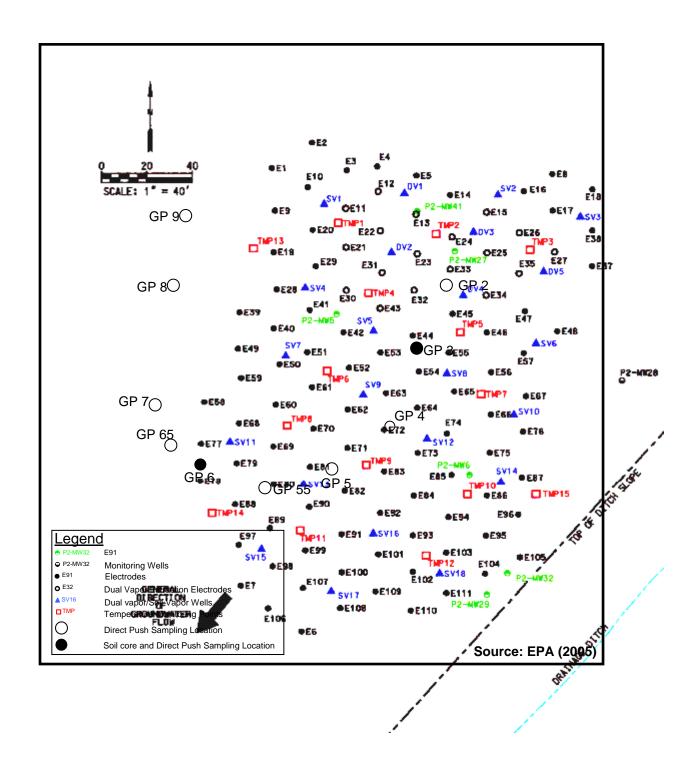


Figure 2. Direct-Push Locations

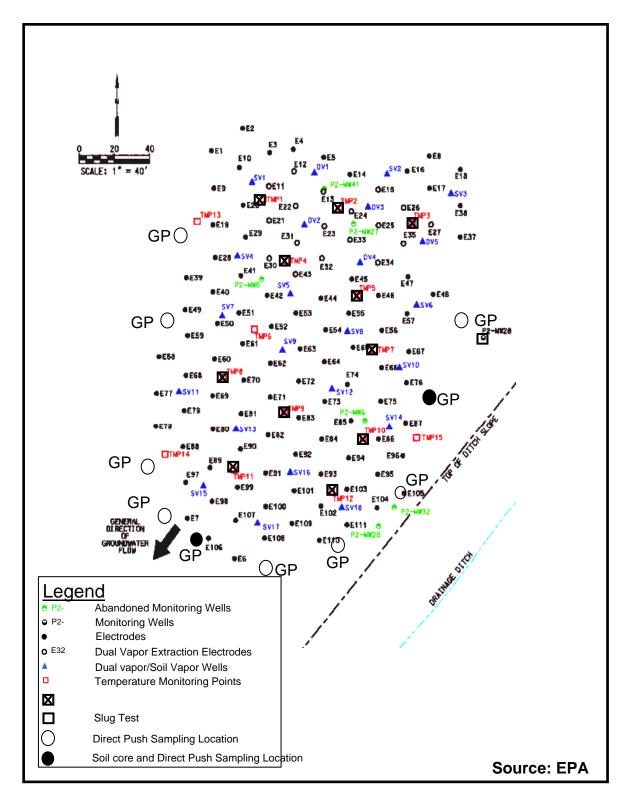


Figure 3. Hydraulic Conductivity Measurement Locations

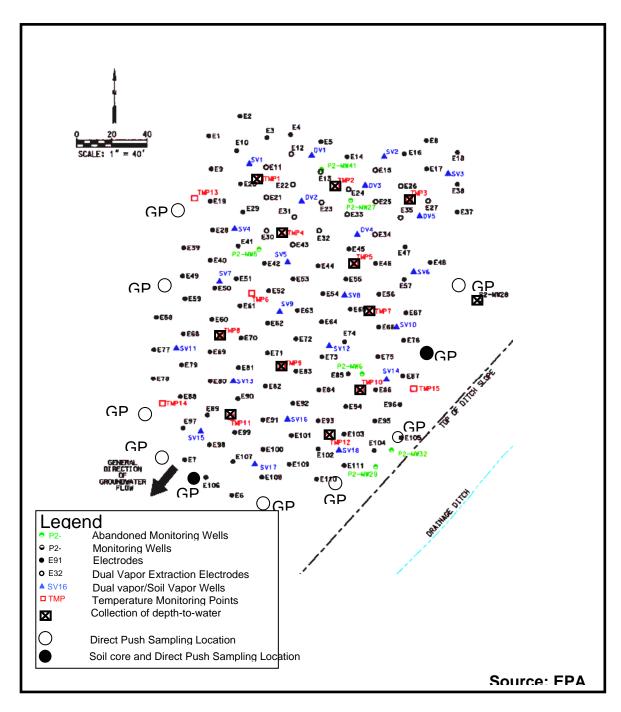


Figure 4. Monitoring Well Depth-to-Water Measurements and Groundwater Sampling Locations

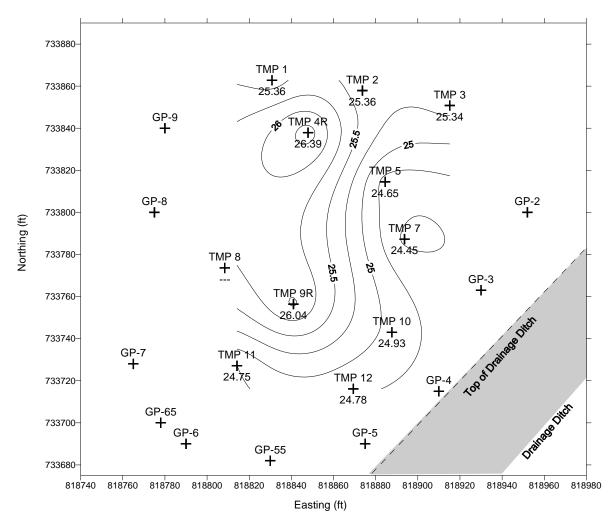


Figure 5. Interpolated Groundwater Elevation Map

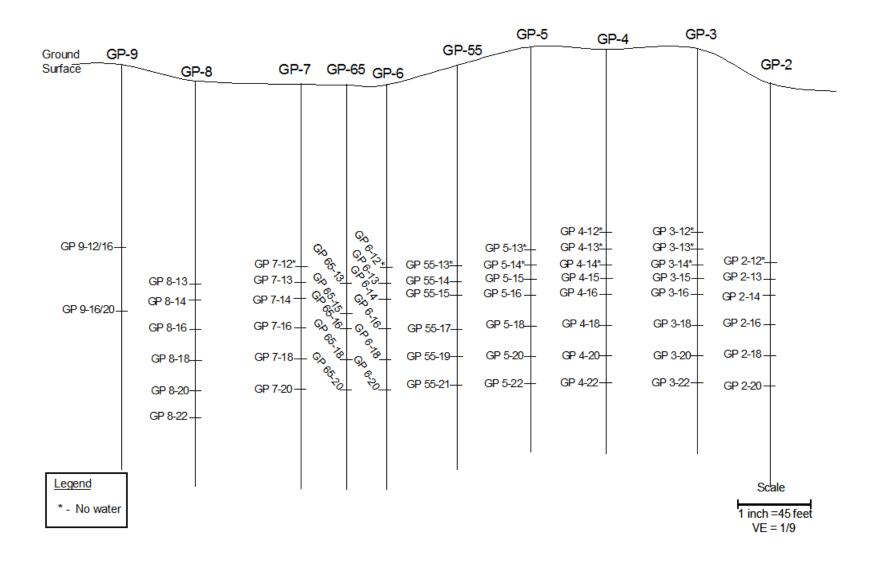
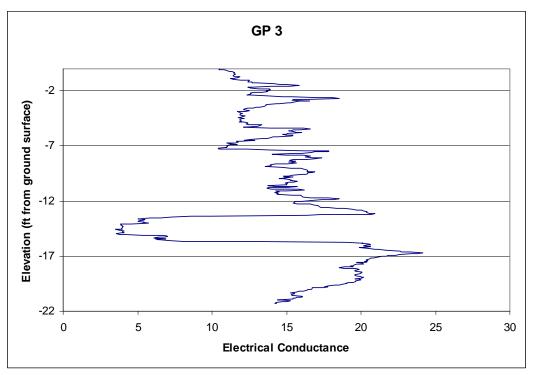
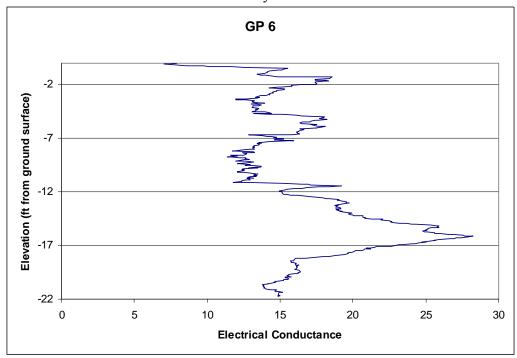


Figure 6. Cross-section of Direct Push Sampling Locations



Electrical Conductivity results for GP 3



Electrical Conductivity results for GP 6

Figure 7. Electrical Conductivity Results

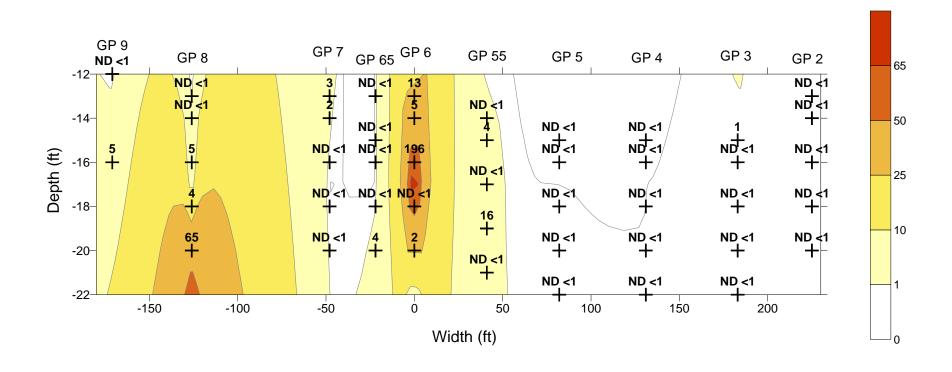


Figure 8. Benzene Direct-Push Groundwater Concentrations (µg/L)

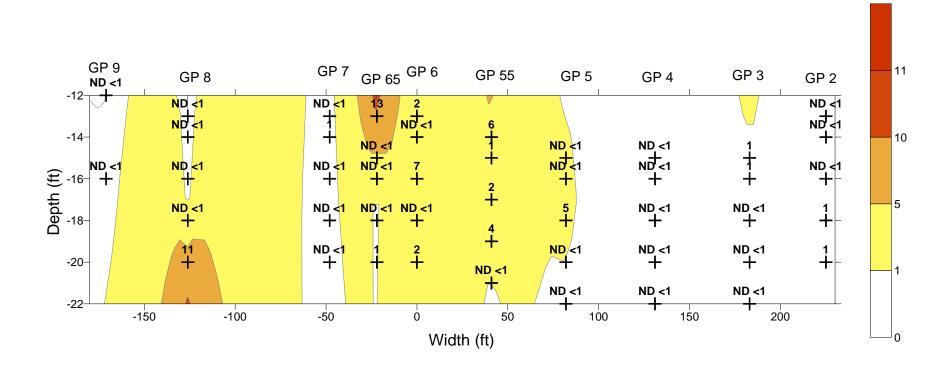


Figure 9. Toluene Direct-Push Groundwater Concentrations (µg/L)

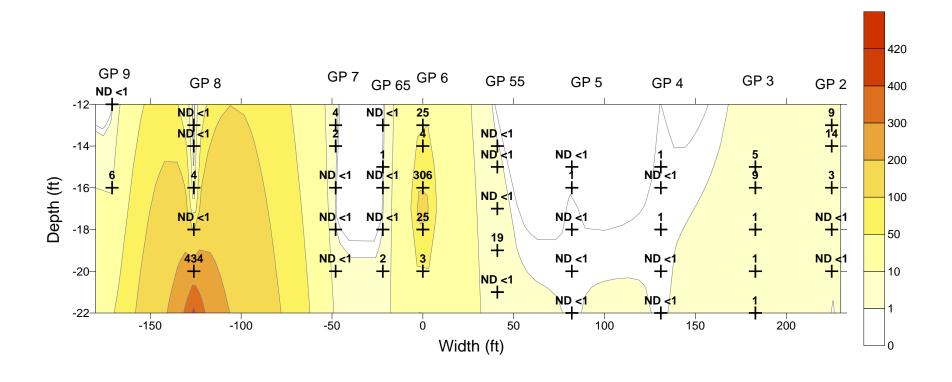


Figure 10. Ethylbenzene Direct-Push Groundwater Concentrations (µg/L)

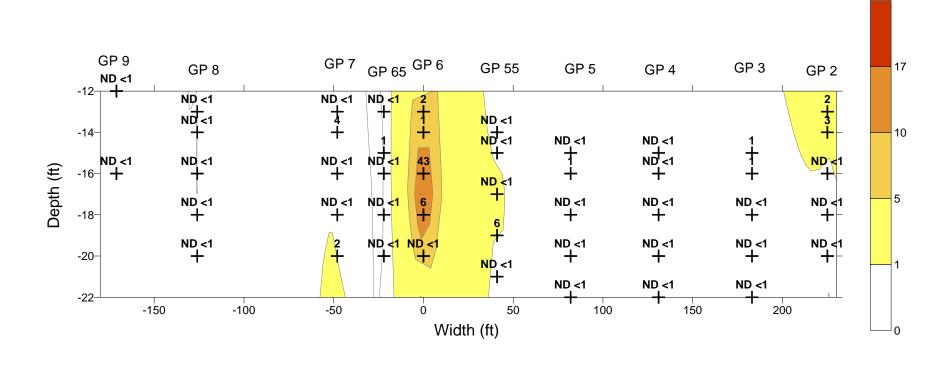


Figure 11. m/p-Xylene Direct-Push Groundwater Concentrations (µg/L)

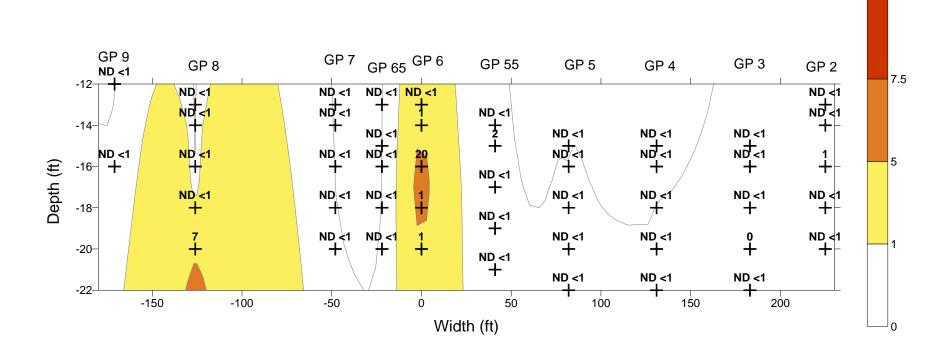


Figure 12. o-Xylene Direct-Push Groundwater Concentrations (µg/L)

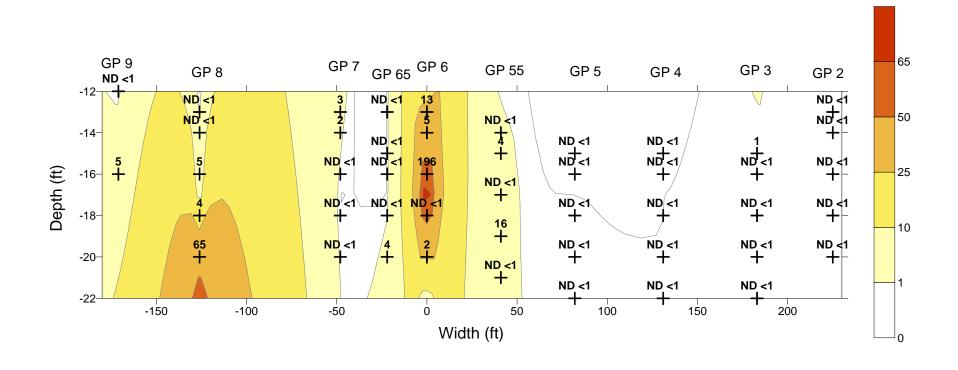


Figure 13. Naphthalene Direct-Push Groundwater Concentrations (µg/L)

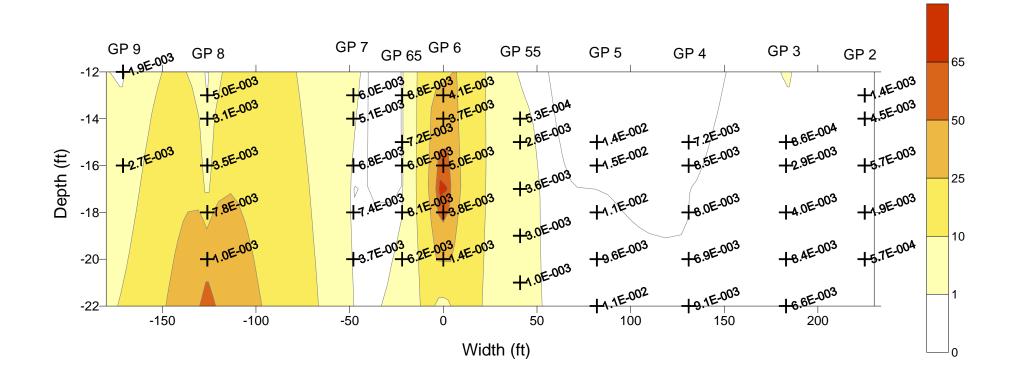


Figure 14. Hydraulic Conductivity Test Data (cm/s) Overlain on Benzene Contour Plot

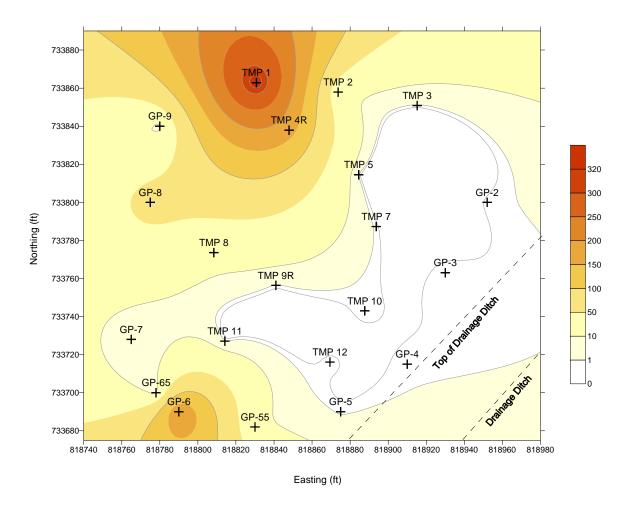


Figure 15. Benzene Contour Plot

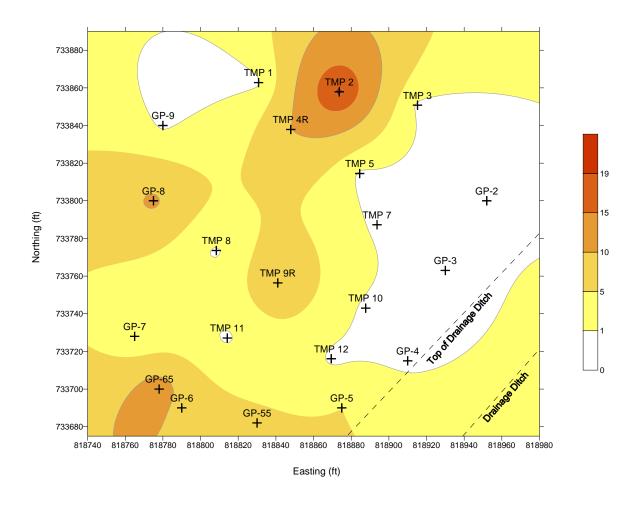


Figure 16. Toluene Contour Plot

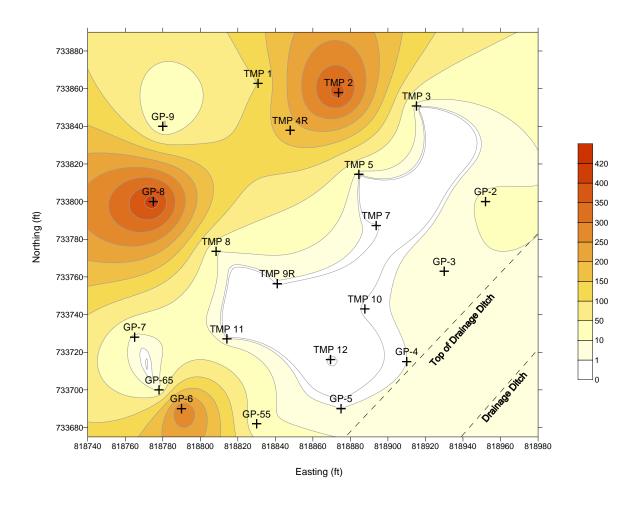


Figure 17. Ethylbenzene Contour Plot

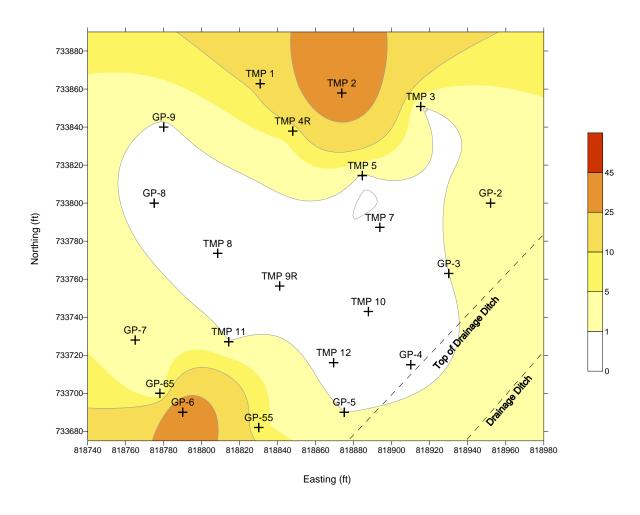


Figure 18. m/p Xylenes Contour Plot

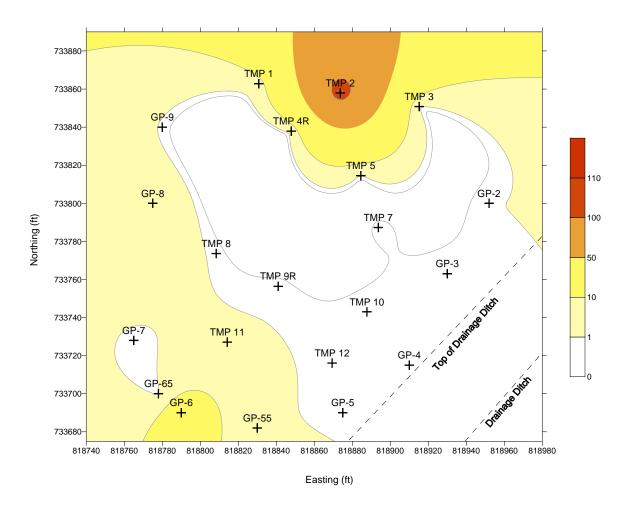


Figure 19. O Xylenes Contour Plot

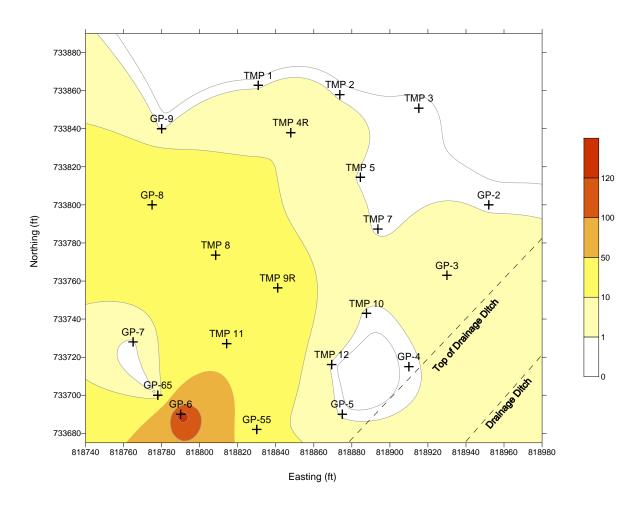


Figure 20. Naphthalene Contour Plot

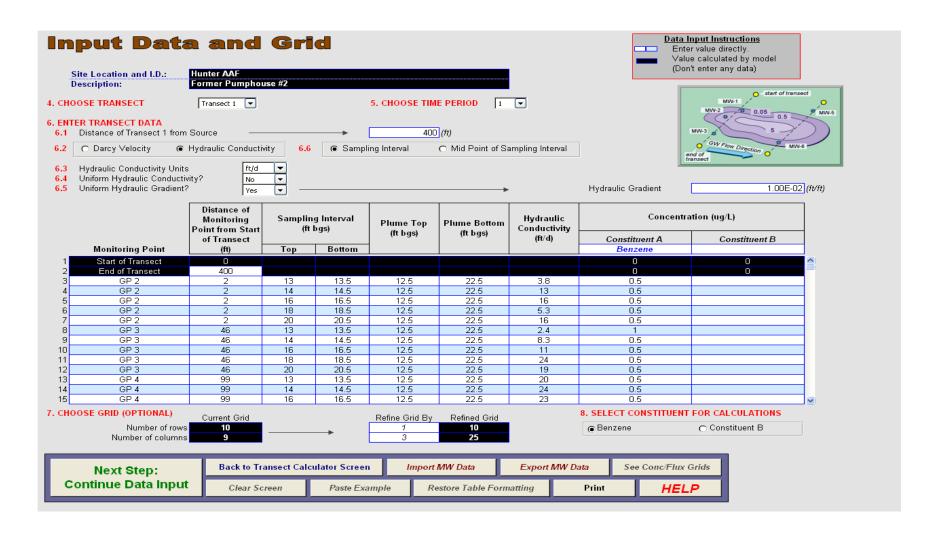


Figure 21. Mass Flux Analysis of Benzene Data

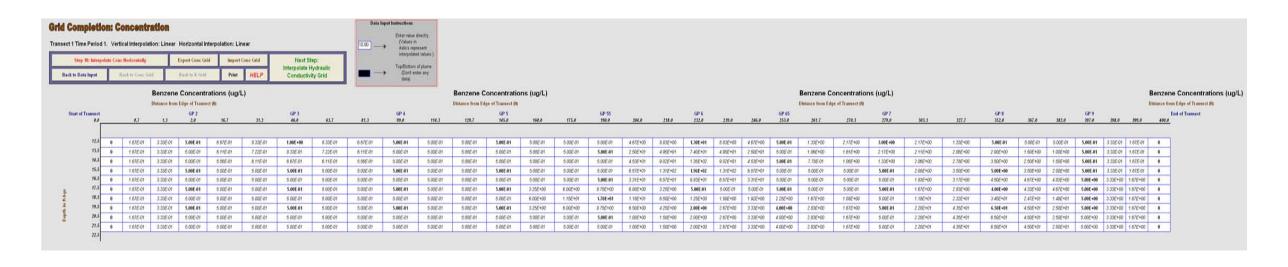


Figure 22. Interpolated Benzene Concentration Grid

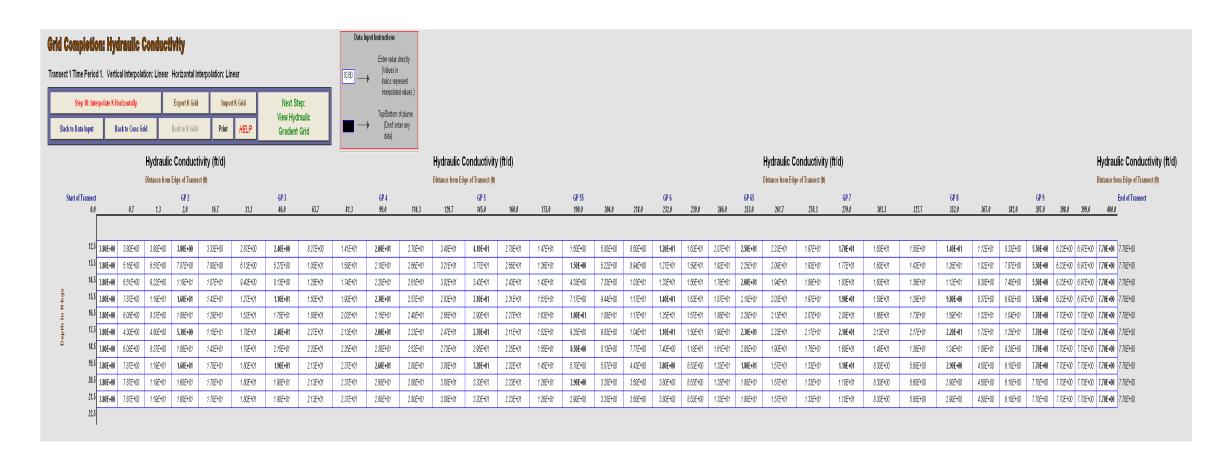


Figure 23. Interpolated Hydraulic Conductivity Grid

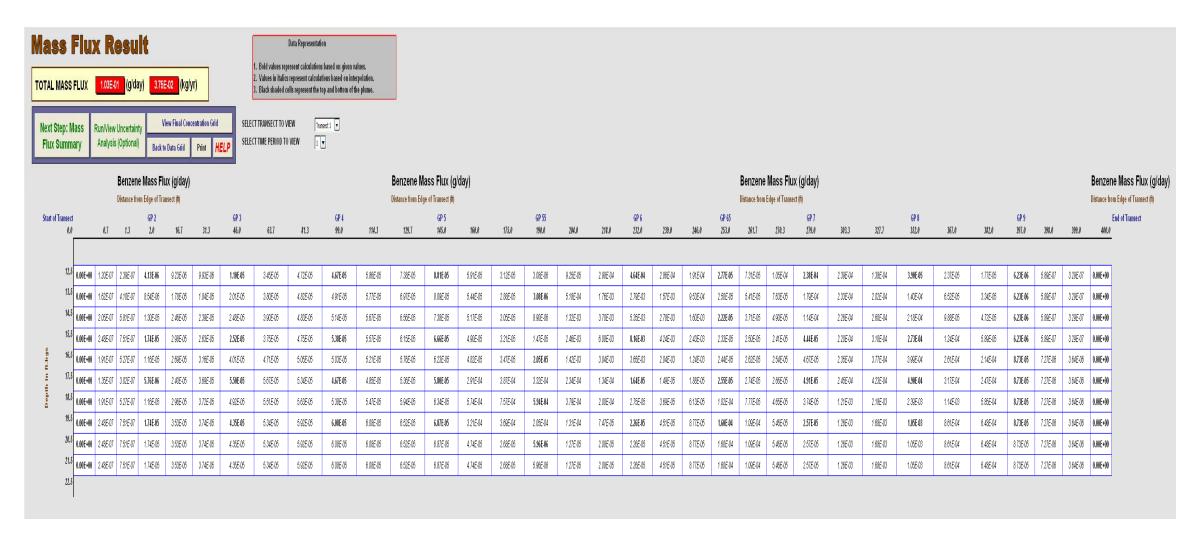


Figure 24. Benzene Mass Flux Results

Tables

Table 1. Geologic Descriptions of Continuous Soil Cores (March/April 2007)

Boring Depth (ft)	Subsurface Features					
Continuous Soil Core GP 3						
0-20	Fine Sand					
Continuous Soil Core GP 6						
0-20	Fine Sand					

Table 2. Sampling Locations and Types of Test Performed (March/April 2007)

Groundwater	Physic	al Assessn	Water Qualit	ty Assessment	
Monitoring Well or Direct-push Sampling Location	Depth-To- Water Measurement	Slug Testing	Constant Drawdown Aquifer Testing	Field Parameters ^(c)	Dissolved Petroleum Hydrocarbon Analysis
TMP 1	Yes		Yes	Yes	Yes
TMP 2	Yes		Yes	Yes	Yes
TMP 3	Yes		Yes	Yes	Yes
TMP 4R	Yes		Yes	Yes	Yes
TMP 5	Yes		Yes	Yes	Yes
TMP 7	Yes		Yes	Yes	Yes
TMP 8	Yes		Yes	Yes	Yes
TMP 9R	Yes		Yes	Yes	Yes
TMP 10	Yes		Yes	Yes	Yes
TMP 11	Yes		Yes	Yes	Yes
TMP 12	Yes		Yes	Yes	Yes
P2-MW28	Yes	Yes		Yes	Yes
GP 2 ^(a)	Yes ^(b)		Yes		Yes
GP 3 ^(a)	Yes ^(b)		Yes		Yes
GP 4 ^(a)	Yes ^(b)		Yes		Yes
GP 5 ^(a)	Yes ^(b)		Yes		Yes
GP 6 ^(a)	Yes ^(b)		Yes		Yes
GP 7 ^a	Yes ^(b)		Yes		Yes
GP 8 ^(a)	Yes ^(b)		Yes		Yes
GP 9 ^(a)	Yes ^(b)		Yes		Yes
GP 55 ^(a)	Yes ^(b)		Yes		Yes
GP 65 ^(a)	Yes ^(b)		Yes		Yes

⁽a) Water quality assessments and constant drawdown tests at direct-push locations were performed on 1 and 2-ft intervals from the phreatic surface (~13' bgs) to 20-22' bgs.

⁽b) Depth to water measurements are approximate and not intended for groundwater elevation calculations.

⁽c) Field parameters include: pH, electrical conductivity, temperature, dissolved oxygen, and oxidation reduction potential.

Table 3. Slug Test Results (March/April 2007)

Monitoring	Well Screen	Hvorslev	Hvorslev	Bouwer and Rice	Bouwer and Rice	
Well	(ft)	K (cm/s)	K (ft/d)	K (cm/s)	K (ft/d)	
P2-MW28	8-18	7.05E-03	19.34	1.34E-03	3.60	

Note:

The total depth of monitoring well P2-MW28 measured approximately 20 ft bgs, which did not correspond with the well completion specifications which reported a total depth of 18 ft bgs.

Table 4. Field Data and Results for Constant Drawdown Aquifer Testing in Monitoring Wells (March/April 2007)

Sampling Location*	Drawdown (ΔH) (ft BSWS**)	Volume purged (ml)	Time (min)	Time (sec)	Total Time (sec)	Q (ft3/s)	Q/ΔH (ft³/ft/s)	K (cm/sec)	K (ft/d)
TMP 1	0.17	3000	2	8	128	8.3E-04	5.0E-03	5.6E-02	1.6E+02
TMP 2	0.25	3000	2	9	129	8.2E-04	3.3E-03	5.5E-02	1.6E+02
TMP 3	0.25	3000	2	1	121	8.8E-04	3.5E-03	4.9E-02	1.4E+02
TMP 4R	0.25	3000	3	8	188	5.6E-04	2.3E-03	2.1E-02	6.1E+01
TMP 5	0.25	2500	1	28	88	1.0E-03	4.0E-03	1.0E-01	2.9E+02
TMP 7	0.25	3000	2	44	164	6.5E-04	2.6E-03	7.9E-02	2.3E+02
TMP 8	0.25	3000	2	14	134	7.9E-04	3.2E-03	4.3E-02	1.2E+02
TMP 9R	0.25	3000	3	50	230	4.6E-04	1.8E-03	2.3E-02	6.6E+01
TMP 10	0.25	3000	2	15	135	7.8E-04	3.1E-03	5.3E-02	1.5E+02
TMP 11	0.25	1500	1	1	61	8.7E-04	3.5E-03	4.3E-02	1.2E+02
TMP 12	0.25	3000	2	55	175	6.1E-04	2.4E-03	5.8E-02	1.6E+02

^{*} See Figure 3

^{**} BSWS – Below estimated static water surface

Table 5. Depth-to-Groundwater and Groundwater Elevations for Monitoring Wells (March/April 2007)

Monitoring Well	Top of Casing Elevation (NGVD29) (ft)	Ground Surface Elevation (NGVD29) (ft)	NAD 27 Northing Coordinate (ft)	NAD 27 Easting Coordinate (ft)	DTW (m BTOC)	DTW (ft BTOC)	Groundwater Elevation (m)	Groundwater Elevation (ft)
TMP 1	39.12	38.40	733862.80	818830.80	4.19	13.76	7.73	25.36
TMP 2	39.84	39.00	733857.90	818873.70	4.42	14.48	7.73	25.36
TMP 3	39.53	38.80	733850.80	818915.20	4.33	14.19	7.72	25.34
TMP 4R	38.51	38.70	733837.90	818847.90	3.69	12.12	8.04	26.39
TMP 5	39.64	38.70	733814.50	818884.50	4.57	14.99	7.51	24.65
TMP 7	39.62	38.80	733787.30	818893.70	4.62	15.17	7.45	24.45
TMP 8			733773.60	818808.40				
TMP 9R	38.03	38.40	733756.40	818841.00	3.65	11.99	7.94	26.04
TMP 10	39.43	38.60	733743.00	818887.70	4.42	14.50	7.60	24.93
TMP 11	38.70	37.80	733727.10	818814.20	4.25	13.95	7.54	24.75
TMP 12	39.71	38.70	733716.10	818869.40	4.55	14.93	7.55	24.78
P2-MW28	N/A	39.40	N/A	N/A	3.97	13.02	8.04	26.38

DTW - Depth-to-water

BTOC - Below top of casing

BGS - Below ground surface

N/A - Data not available

NAD 27 – North American Datum of 1927

NGVD29 - National Geodetic Vertical Datum of 1929

--- Unable to take a water level reading because casing was destroyed

Table 6. Water Quality Data for Monitoring Wells (March/April 2007)

Monitoring	Water Quality Data ^(a)									
Well	pН	EC (mS)	Temperature (°C)	DO (mg/L)	ORP (mV)					
TMP 1	6.4	0.56	20.4	1.1	-50					
TMP 2	6.7	0.40	20.0	0.8	-160					
TMP 3	6.3	0.23	19.6	1.1	-4					
TMP 4R	6.4	0.50	20.4	0.9	-163					
TMP 5	6.2	0.32	20.3	1.2	-10					
TMP 7	6.0	0.40	20.5	1.5	11					
TMP 8	6.3	0.43	20.4	1.2	-9					
TMP 9R	6.4	0.39	20.8	1.2	14					
TMP 10	5.8	0.30	21.5	1.3	45					
TMP 11	6.1	0.45	21.9	1.5	-13					
TMP 12	6.3	0.30	22.0	1.7	51					
P2-MW28	5.3	0.09	20.8	1.0	66					

⁽a) All measurements were made with a Horiba U-22 meter.

EC = electrical conductivity

DO = dissolved oxygen
ORP = oxidation-reduction potential

Table 7. Chemical Concentration Data for Monitoring Wells (March/April 2007)

Monitoring			Concenti	ation (µg/L)		
Well	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Naphthalene
TMP 1	342	1	98	12	5	<1
TMP 2	16	16	377	46	115	<1
TMP 2 DUP	<1	13	361	45	124	<1
TMP 3	<1	<1	2	1	<1	<1
TMP 3 REP	<1	<1	<1	1	<1	<1
TMP 4R	171	15	182	7	2	12
TMP 4R DUP	192	18	<1	8	5	20
TMP 5	<1	1	<1	<1	<1	<1
TMP 7	<1	4	<1	<1	<1	<1
TMP 8	23	4	11	<1	<1	8
TMP 9R	<1	8	4	1	<1	16
TMP 10	<1	1	<1	<1	<1	<1
TMP 11	2	3	1	1	2	43
TMP11 DUP	2	3	1	1	1	41
TMP 12	<1	1	<1	<1	<1	<1
TMP 12 REP	<1	1	<1	<1	1	<1
P2-MW28	<1	<1	2	<1	<1	<1

DUP - Duplicate sample REP - Quality control sample (second analysis of same water sample)

Table 8. Chemical Concentration Data for Direct-Push Downgradient Transect Locations (March/April 2007)

Sampling	-	Tunsect L	Concent	ration (µg/L)	<u>'</u>	
Location*	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Naphthalene
GP 2-13	<1	<1	9	2	<1	<1
GP 2-14	<1	<1	14	3	<1	<1
GP 2-16	<1	<1	3	<1	1	<1
GP 2-18	<1	1	<1	<1	<1	<1
GP 2-20	<1	1	<1	<1	<1	<1
GP 3-15	1	1	5	1	<1	<1
GP 3-15 REP	1	1	4	1	<1	<1
GP 3-16	<1	1	9	1	<1	2
GP 3-18	<1	<1	1	<1	<1	7
GP 3-20	<1	<1	1	<1	<1	<1
GP 3-22	<1	<1	1	<1	<1	<1
GP 4-15	<1	<1	1	<1	<1	<1
GP 4-16	<1	<1	<1	<1	<1	<1
GP 4-18	<1	<1	1	<1	<1	<1
GP 4-20	<1	0	<1	<1	<1	<1
GP 4-20 DUP	<1	0	<1	<1	<1	<1
GP 4-22	<1	<1	<1	<1	<1	<1
GP 5-15	<1	<1	<1	<1	<1	<1
GP 5-16	<1	<1	1	1	<1	<1
GP 5-18	<1	5	<1	<1	<1	<1
GP 5-18 DUP	<1	<1	<1	<1	<1	<1
GP 5-20	<1	<1	<1	<1	<1	<1
GP 5-22	<1	<1	<1	<1	<1	<1
GP 5-22 REP	<1	<1	<1	<1	<1	<1
GP 55-14	<1	6	<1	<1	<1	<1
GP 55-15	4	1	<1	<1	2	16
GP 55-17	<1	2	<1	<1	<1	<1
GP 55-19	16	4	19	6	<1	13
GP 55-19 REP	18	5	18	6	<1	9
GP 55-21	<1	<1	<1	<1	<1	<1
GP 6-13	13	2	25	2	<1	<1
GP 6-14	5	<1	4	<1	<1	<1
GP 6-14 DUP	<1	8	6	2	1	27
GP 6-16	196	7	306	43	20	132
GP 6-18	<1	<1	25	6	1	19
GP 6-20	2	2	3	<1	1	<1
GP 65-13	<1	13	<1	<1	<1	<1
GP 65-15	<1	<1	1	1	<1	<1
GP 65-16	<1	<1	<1	<1	<1	<1
GP 65-18	<1	<1	<1	<1	<1	<1
GP 65-18 DUP	<1	<1	<1	<1	<1	<1
GP 65-20	4	1	2	<1	<1	<1
GP 7-13	3	<1	4	<1	<1	<1
GP 7-14	2	1	2	4	<1	<1
GP 7-14	<1	<1	<1	<1	<1	<1
GP 7-18	<1	<1	<1	<1	<1	<1
GP 7-18	<1	<1	<1	2	<1	<1
						<1
GP 8-13	<1	<1	<1	<1	<1	<u> </u>

Sampling	Concentration (μg/L)								
Location*	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Naphthalene			
GP 8-14	<1	<1	<1	<1	<1	<1			
GP 8-16	5	<1	4	<1	<1	<1			
GP 8-18	4	<1	<1	<1	<1	<1			
GP 8-18 REP	<1	<1	<1	<1	<1	<1			
GP 8-20	65	11	434	<1	7	40			
GP 9-12/16	<1	<1	<1	<1	<1	<1			
GP 9-16/20	5	<1	6	<1	<1	<1			

See Figure 1

DUP = Duplicate sample, REP = Quality control sample (second analysis of same water sample)

Table 9. Water Quality Data for Direct-Push Downgradient Transect Locations (March/April 2007)

Monitoria - Wall	Water Quality Data ^(a)									
Monitoring Well	pН	EC (mS)	Temperature (°C)	DO (mg/L)	ORP (mV)					
GP 2-13										
GP 2-14										
GP 2-16										
GP 2-18	5.6	0.06	22.5	1.0	24					
GP 2-20										
GP 3-15										
GP 3-16										
GP 3-18	5.9	0.23	22.3	1.0	-17					
GP 3-20	5.7	0.10	22.5	0.9	28					
GP 3-22										
GP 4-15										
GP 4-16	6.2	0.41	21.6	0.8	-7					
GP 4-18	6.1	0.25	22.3	0.9	19					
GP 4-20	6.0	0.11	23.1	1.0	59					
GP 4-22	6.1	0.04	23.3	0.9	46					
GP 5-15										
GP 5-16	6.2	0.56	23.0	1.0	-9					
GP 5-18	6.0	0.50	23.1	0.9	13					
GP 5-20	5.5	0.21	23.8	1.0	90					
GP 5-22	5.8	0.04	23.7	0.8	77					
GP 6-13										
GP 6-14										
GP 6-16	6.4	0.64	25.4	1.1	-60					
GP 6-18	5.2	0.18	25.0	1.1	22					
GP 6-20	5.5	0.04	25.1	0.9	84					
GP 7-13										
GP 7-14	6.0	0.56	23.0	1.8	-21					
GP 7-16	5.8	0.29	23.1	1.2	5					
GP 7-18	5.8	0.12	22.5	0.8	21					
GP 7-20	5.8	0.04	22.3	0.7	110					
GP 8-13										
GP 8-14	6.5	0.42	18.8	1.0	-20					
GP 8-16	6.4	0.22	20.6	1.0	-35					
GP 8-18	6.2	0.12	21.3	1.7	-7					
GP 8-20										
GP 9-12/16	6.0	0.28	22.3	1.0	-30					
GP 9-16/20	5.9	0.13	22.1	1.2	19					
GP 55-14										
GP 55-15	6.2	0.28	22.4	2.7	12					
GP 55-17	6.5	0.26	22.3	1.5	-47					

Monitoring Well	Water Quality Data ^(a)								
Withintoring Wen	pH EC (mS)		Temperature (°C)	DO (mg/L)	ORP (mV)				
GP 55-19	5.8	0.31	23.0	1.3	24				
GP 55-21	5.9	0.06	23.5	1.0	35				
GP 65-13									
GP 65-15	5.9	0.64	22.1	1.0	-39				
GP 65-16	5.9	0.30	21.8	0.9	-3				
GP 65-18	5.5	0.09	22.0	0.9	78				
GP 65-20	5.6	0.03	22.4	0.8	78				

⁽a) All measurements were made with a Horiba U-22 meter.

⁻⁻⁻ No water quality data taken
EC = electrical conductivity
DO = dissolved oxygen
ORP = oxidation-reduction potential

Table 10. Field Data and Results for Constant Drawdown Aquifer Testing in Direct-Push Downgradient Transect Locations (March/April 2007)

·				mseet E	ocacions (1)	rai cii/Aprii	= = = = = = = = = = = = = = = = = = = =			
Sampling Location*	Drawdown (ΔH) (ft BSWS**)	Volume purged (ml)	Time (min)	Time (sec)	Total Time (sec)	Q (ft3/s)	Q/ΔH (ft ³ /ft/s)	K (ft/sec)	K (cm/sec)	K (ft/d)
GP 2-13	0.67	60	2	0	120	1.8E-05	2.6E-05	4.4E-05	1.3E-03	3.8E+00
GP 2-14	1.00	150	1	0	60	8.8E-05	8.8E-05	1.5E-04	4.4E-03	1.3E+01
GP 2-16	1.00	190	1	0	60	1.1E-04	1.1E-04	1.8E-04	5.6E-03	1.6E+01
GP 2-18	3.00	280	1	30	90	1.1E-04	3.7E-05	6.0E-05	1.8E-03	5.2E+00
GP 2-20	3.00	170	3	0	180	3.3E-05	1.1E-05	1.8E-05	5.6E-04	1.6E+00
GP 3-15	0.58	50	3	0	180	9.8E-06	1.7E-05	2.8E-05	8.4E-04	2.4E+00
GP 3-16	1.50	220	1	30	90	8.6E-05	5.8E-05	9.5E-05	2.9E-03	8.2E+00
GP 3-18	3.00	300	0	45	45	2.4E-04	7.8E-05	1.3E-04	3.9E-03	1.1E+01
GP 3-20	1.00	210	0	45	45	1.6E-04	1.6E-04	2.7E-04	8.3E-03	2.3E+01
GP 3-22	1.00	220	1	0	60	1.3E-04	1.3E-04	2.1E-04	6.5E-03	1.8E+01
GP 4-15	0.50	180	1	30	90	7.1E-05	1.4E-04	2.3E-04	7.1E-03	2.0E+01
GP 4-16	1.50	320	0	45	45	2.5E-04	1.7E-04	2.8E-04	8.4E-03	2.4E+01
GP 4-18	1.50	300	0	45	45	2.4E-04	1.6E-04	2.6E-04	7.9E-03	2.2E+01
GP 4-20	1.50	260	0	45	45	2.0E-04	1.4E-04	2.2E-04	6.8E-03	1.9E+01
GP 4-22	1.50	340	0	45	45	2.7E-04	1.8E-04	2.9E-04	8.9E-03	2.5E+01
GP 5-15	0.50	240	1	0	60	1.4E-04	2.8E-04	4.6E-04	1.4E-02	4.0E+01
GP 5-16	1.00	250	0	30	30	2.9E-04	2.9E-04	4.8E-04	1.5E-02	4.2E+01
GP 5-18	1.00	270	0	45	45	2.1E-04	2.1E-04	3.5E-04	1.1E-02	3.0E+01
GP 5-20	1.00	240	0	45	45	1.9E-04	1.9E-04	3.1E-04	9.4E-03	2.7E+01
GP 5-22	1.00	280	0	45	45	2.2E-04	2.2E-04	3.6E-04	1.1E-02	3.1E+01
GP 6-13	0.25	120	3	30	210	2.0E-05	8.1E-05	1.3E-04	4.0E-03	1.1E+01
GP 6-14	0.75	140	1	30	90	5.5E-05	7.3E-05	1.2E-04	3.7E-03	1.0E+01
GP 6-16	1.67	280	1	0	60	1.6E-04	9.9E-05	1.6E-04	5.0E-03	1.4E+01
GP 6-18	2.00	250	1	0	60	1.5E-04	7.4E-05	1.2E-04	3.7E-03	1.0E+01
GP 6-20	2.00	180	2	0	120	5.3E-05	2.6E-05	4.4E-05	1.3E-03	3.8E+00
GP 7-13	0.50	300	3	0	180	5.9E-05	1.2E-04	1.9E-04	5.9E-03	1.7E+01
GP 7-14	1.00	340	2	0	120	1.0E-04	1.0E-04	1.6E-04	5.0E-03	1.4E+01
GP 7-16	1.50	340	1	0	60	2.0E-04	1.3E-04	2.2E-04	6.7E-03	1.9E+01

Sampling Location*	Drawdown (ΔH) (ft BSWS**)	Volume purged (ml)	Time (min)	Time (sec)	Total Time (sec)	Q (ft3/s)	Q/ΔH (ft ³ /ft/s)	K (ft/sec)	K (cm/sec)	K (ft/d)
GP 7-18	1.50	370	1	0	60	2.2E-04	1.5E-04	2.4E-04	7.3E-03	2.1E+01
GP 7-20	2.50	310	1	0	60	1.8E-04	7.3E-05	1.2E-04	3.7E-03	1.0E+01
GP 8-13	0.50	250	3	0	180	4.9E-05	9.8E-05	1.6E-04	4.9E-03	1.4E+01
GP 8-14	1.50	310	2	0	120	9.1E-05	6.1E-05	1.0E-04	3.0E-03	8.6E+00
GP 8-16	2.00	230	1	0	60	1.4E-04	6.8E-05	1.1E-04	3.4E-03	9.6E+00
GP 8-18	1.50	390	1	0	60	2.3E-04	1.5E-04	2.5E-04	7.7E-03	2.2E+01
GP 8-20	7.83	270	1	0	60	1.6E-04	2.0E-05	3.3E-05	1.0E-03	2.9E+00
GP 9-12/16	0.75	1000	2	35	155	2.3E-04	3.0E-04	6.2E-05	1.9E-03	5.4E+00
GP 9-16/20	1.00	3000	4	10	250	4.2E-04	4.2E-04	8.7E-05	2.7E-03	7.5E+00
GP 55-14	0.42	55	3	0	180	1.1E-05	2.6E-05	4.3E-05	1.3E-03	3.7E+00
GP 55-15	1.33	235	2	0	120	6.9E-05	5.2E-05	8.5E-05	2.6E-03	7.4E+00
GP 55-17	3.00	360	1	0	60	2.1E-04	7.1E-05	1.2E-04	3.5E-03	1.0E+01
GP 55-19	3.00	300	1	0	60	1.8E-04	5.9E-05	9.7E-05	2.9E-03	8.4E+00
GP 55-21	3.50	120	1	0	60	7.1E-05	2.0E-05	3.3E-05	1.0E-03	2.9E+00
GP 65-13	0.92	270	1	0	60	1.6E-04	1.7E-04	2.8E-04	8.7E-03	2.5E+01
GP 65-15	1.00	240	1	0	60	1.4E-04	1.4E-04	2.3E-04	7.1E-03	2.0E+01
GP 65-16	1.00	200	1	0	60	1.2E-04	1.2E-04	1.9E-04	5.9E-03	1.7E+01
GP 65-18	2.00	270	0	30	30	3.2E-04	1.6E-04	2.6E-04	8.0E-03	2.3E+01
GP 65-20	1.50	310	1	0	60	1.8E-04	1.2E-04	2.0E-04	6.1E-03	1.7E+01

^{*} See Figure 2
** BSWS – Below estimated static water surface

Table 11. Monitoring Well Chemical Concentration Data Comparison

	Benzene		Toluene		Ethylbenzene		Total Xylenes		Naphthalene	
Sample Location	ASU (Mar/Apr '07)	HunterAAF (July '05)	ASU (Mar/Apr '07)	HunterAAF (July '05)	ASU (Mar/Apr '07)	Hunter AAF (July '05)	ASU (Mar/Apr '07)	Hunter AAF (July '05)	ASU (Mar/Apr '07)	Hunter AAF (July '05)
	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L
TMP 1	340	37.3	<1	6.9	100	193	17	9.8	<1	12.5
TMP 2	20	519	20	137	380	257	161	296	<1	147
TMP 2 DUP	<1	519	10	137	360	257	169	296	<1	147
TMP 3	<1	0.37 J	<1	3.2	<1	1.2	1	1 U	<1	0.45 J
TMP 3 REP	<1	0.37 J	<1	3.2	<1	1.2	1	1 U	<1	0.45 J
TMP 4R	170	1730	10	267	180	635	9	714	10	23.2
TMP 4R DUP	190	1730	20	267	<1	635	13	714	20	23.2
TMP 5	<1	11.3	<1	7	<1	39.9	<1	17.7	<1	1.6
TMP 7	<1	0.35 J	<1	3.3	<1	0.26 J	1	1U	<1	N/A
TMP 8	20	1.6	<1	3	10	1.5	<1	1.2 U	10	0.74 J
TMP 9R	<1	92.6	10	5.5	<1	76.4	1	7.5	20	6.1
TMP 10	<1	1 U	<1	4.8	<1	0.3 J	<1	1 U	<1	N/A
TMP 11	<1	1.2	<1	5.3	<1	1 U	2	1 U	40	N/A
TMP11 DUP	<1	1.2	<1	5.3	<1	1 U	2	1 U	40	N/A
TMP 12	<1	5.4	<1	3.7	<1	0.62 J	<1	1 U	<1	1.3
TMP 12 REP	<1	5.4	<1	3.7	<1	0.62 J	1	1 U	<1	1.3
P2-MW28	<1	N/A	<1	N/A	<1	N/A	<1	N/A	<1	N/A

N/A – No Data Available

Dup – Duplicate Sample REP – Quality Control Sample (second analysis of same sample)

Draft Final

Data Analysis Report for Ft. Lewis, Washington – Area 3

Critical Evaluation of the State of In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment

Prepared for:



Environmental Security Technology Certification Program Arlington, VA

Prepared by:

Arizona State University Battelle

January 2008

The vendors and products, including the equipment, system components, and other materials identified in this report, are primarily for information purposes only. Although some of these
vendors and products may have been used in the past, mention in this report does not constitute a recommendation for using these vendors or products.

Contents

FIGURES	236
TABLES	236
ACRONYMS AND ABBREVIATIONS	237
1. INTRODUCTION	238
2. FIELD INVESTIGATION	238
Figures	
Figure 1. Site Map Figure 2. Average Groundwater Temperature (within ERH Treatment Zone) Figure 3. Monitoring Well C07 Data Figure 4. Monitoring Well E03 Data Figure 5. Monitoring Well E10 Data Figure 6. Monitoring Well FX3-1 Data Figure 7. Monitoring Well FX3-1 Data Figure 8. Monitoring Well FX3-12 Data Figure 9. Monitoring Well FX3-2 Data Figure 10. Monitoring Well FX3-2 Data Figure 11. Monitoring Well FX3-4 Data Figure 12. Monitoring Well FX3-6 Data Figure 13. Monitoring Well H06 Data Figure 14. Monitoring Well K02 Data Figure 15. Monitoring Well LC-138 Data Figure 16. Monitoring Well LC-156 Data Figure 17. Monitoring Well LC-64A Data Figure 18. Monitoring Well M08 Data Figure 19. Monitoring Well P05 Data	
Tables	

Tables

- Table 1. Groundwater Sampling Locations
- Table 2. Groundwater Monitoring Well Analytical Data
- Table 3. Groundwater Monitoring Well Water Temperatures
- Table 4. Groundwater Treatment Zone Average Water Temperature
- Table 5. Mass Flux Analysis

Acronyms and Abbreviations

DELCD dry electrolytic conductivity detector

ERH electrical resistance heating

ESTCP Environmental Security Technology Certification Program

FID flame-ionization detector

ft feet

GC gas chromatography

kg kilogram

PID photo-ionization detector

USACE U.S. Army Corps of Engineers

VOA volatile organic analysis

yr year

1. Introduction

The post-treatment field investigation of Ft. Lewis, Washington – Area 3 (Area 3), under the Environmental Security Technology Certification Program (ESTCP) project CU-0314, *Critical Evaluation of State of the In-Situ Thermal Treatment Technologies*, was performed June 6, 2006 to September 25, 2007. Consistent with the objectives set forth in the CU-0314 Demonstration Plan, field investigations at this site focused on the collection of data to determine dissolved groundwater concentrations and the mass discharge immediately downgradient from the remediated source zone.

The investigation at Area 3 was different than the other field investigations performed under CU-0314; this was the only investigation that spanned the complete treatment cycle of an in-situ thermal remedial application. Since the electrical resistance heating (ERH) application at Area 3 was undergoing installation when field investigations for CU-0314 began, it was decided that pre-, active-, and post-treatment groundwater samples would be collected from existing upgradient, treatment zone, and downgradient groundwater monitoring wells. This monitoring approach provided a comprehensive set of data that allowed for pre- versus post-treatment groundwater data analysis, the ability to assess treatment temperature and groundwater concentration versus time and location, and with existing hydraulic conductivity information generated by the contractor, the ability to calculate a mass discharge from the treatment zone immediately following the application.

2. Field InvestigationS

In accordance with the approved generic demonstration plan for this project, the following site-specific activities were conducted:

- 1. Collection of groundwater samples from 5 upgradient, 8 treatment-zone, and 4 downgradient groundwater monitoring wells (see Figure 1) for analysis of dissolved chlorinated and petroleum hydrocarbon concentrations. Samples were collected and analyzed for the pre-, during-, and post-treatment thermal time periods.
 - a. Table 1 identifies the groundwater monitoring wells from which samples were collected. Groundwater was collected by United States Army Corps of Engineers (USACE) personnel for analysis and stored in volatile organic analysis (VOA) vials preserved hydrochloric acid. Samples were packaged and shipped to Arizona State University where they were analyzed for dissolved chlorinated and petroleum hydrocarbon concentrations by heated-headspace analysis and gas chromatography (GC) using a photo-ionization detector (PID), a flame-ionization detector (FID), and a dry electrolytic conductivity detector (DELCD). Chemical concentration data can be found in Table 2. During the post-treatment sample analysis, 1,1-dichloroethene (DCE), was detected. Therefore, 1,1-DCE analysis was then performed on the pre- and during treatment samples, but it was not detected. All non-detect samples are listed as less than the detection limit.

All monitoring well chemical concentration data has associated sampling temperature data. Temperature data is based on either in-situ thermocouple measurements (for wells within the treatment zone) or field measurements of purge water (for wells outside of treatment zone). Table 3 presents the monitoring well sampling temperature data. An average treatment zone groundwater temperature was calculated from thermocouple data and can be found in Table 4 and Figure 2.

The dissolved chemical concentration data and average treatment zone temperature were plotted against time for each monitoring well. Figures 3 through 19 represent these data parameters.

Using the dissolved TCE groundwater concentration data and hydraulic conductivity measurements made by USACE personnel/contractors for monitoring wells around Area 3, a TCE mass flux calculation was performed¹. Hydraulic conductivity measurements ranged from 38 to 120 ft/day with an average of 65 ft/day. This range of hydraulic conductivity values was used when determining the mass flux. Ft. Lewis also has a variable hydraulic gradients based on the time of year. A range of hydraulic gradient values was found based on groundwater elevation data recorded throughout 2006-2007. This range of measurements was used in determining the mass flux to provide a reasonable range of values based on the seasonal variations. Table 5 presents the mass flux discharge numbers. The mass flux results for TCE are estimated to be 1.42E-01 to 1.57E+00 kg/yr.

-

¹ The Mass Flux Toolkit Version 1.0 was used to calculate the mass flux. The Mass Flux Toolkit is a freeware program developed by Groundwater Services, Inc. and others under a contract funded by ESTCP.

Figures

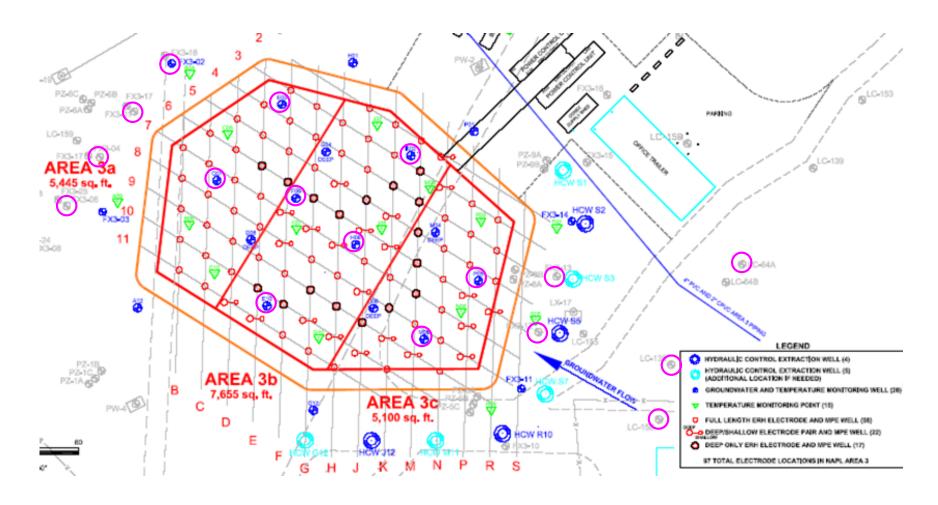


Figure 1. Site Map

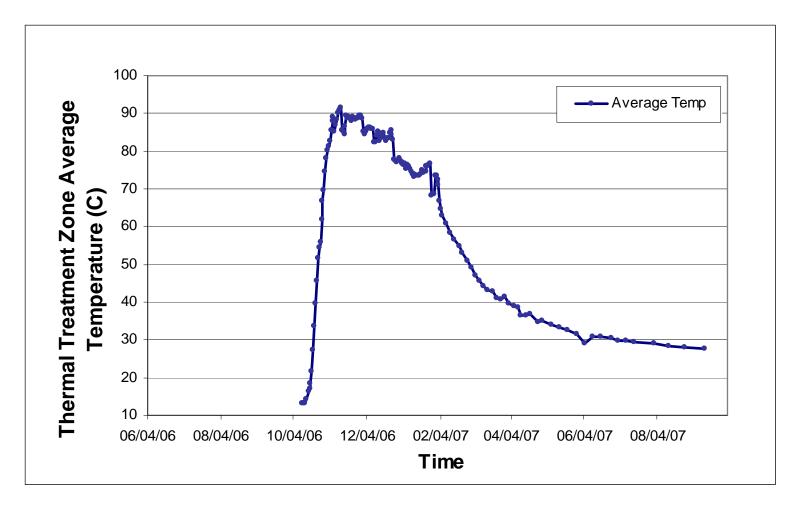


Figure 2. Average Groundwater Temperature (within ERH Treatment Zone)

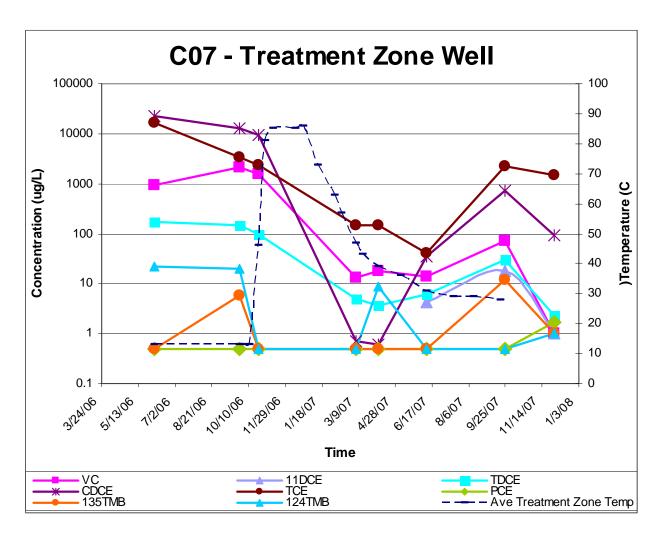


Figure 3. Monitoring Well C07 Data

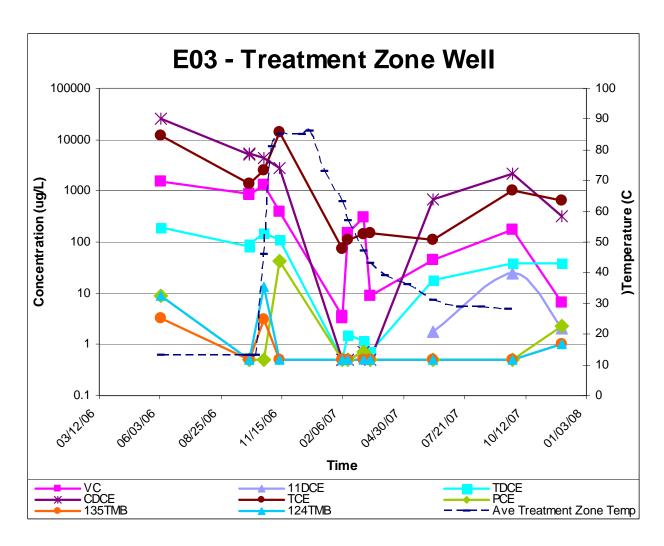


Figure 4. Monitoring Well E03 Data

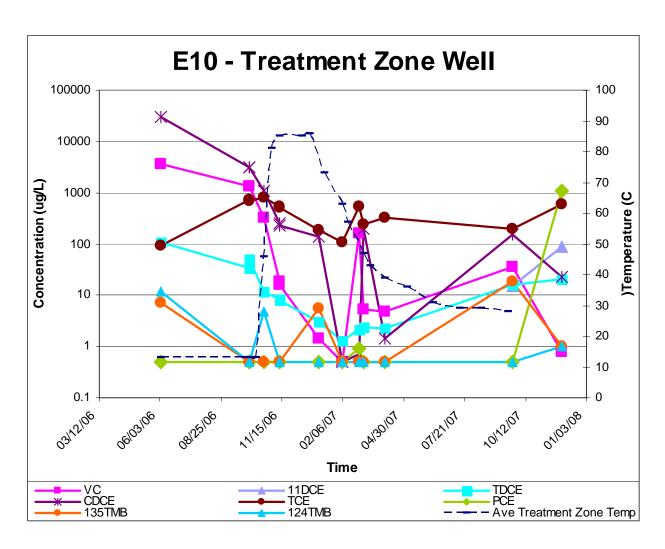


Figure 5. Monitoring Well E10 Data

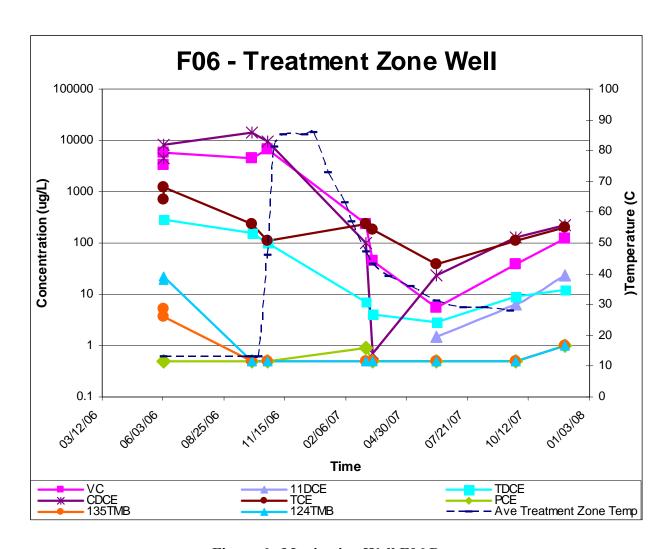


Figure 6. Monitoring Well F06 Data

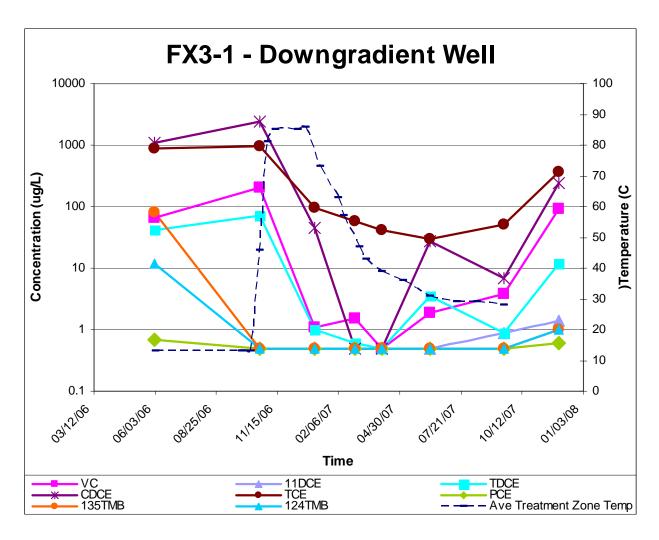


Figure 7. Monitoring Well FX3-1 Data

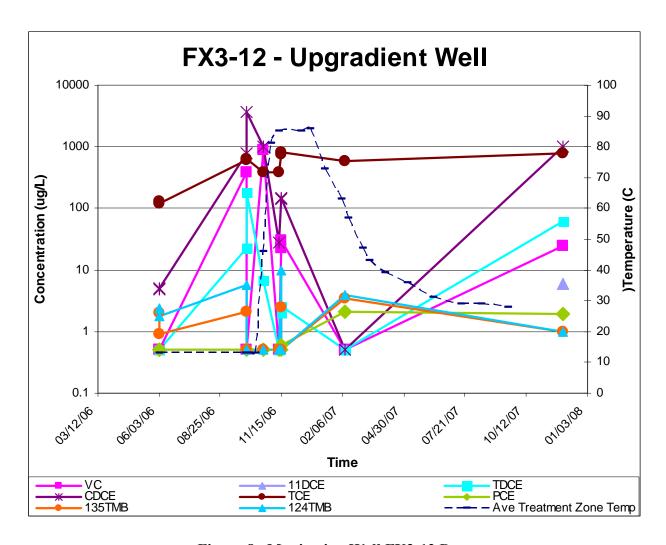


Figure 8. Monitoring Well FX3-12 Data

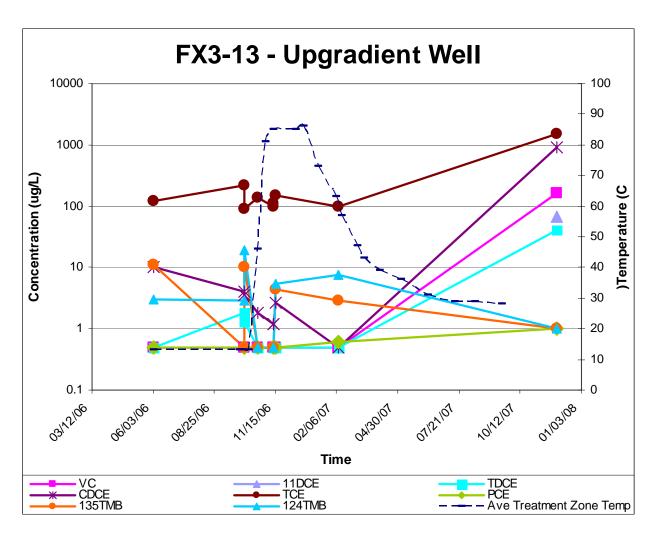


Figure 9. Monitoring Well FX3-13 Data

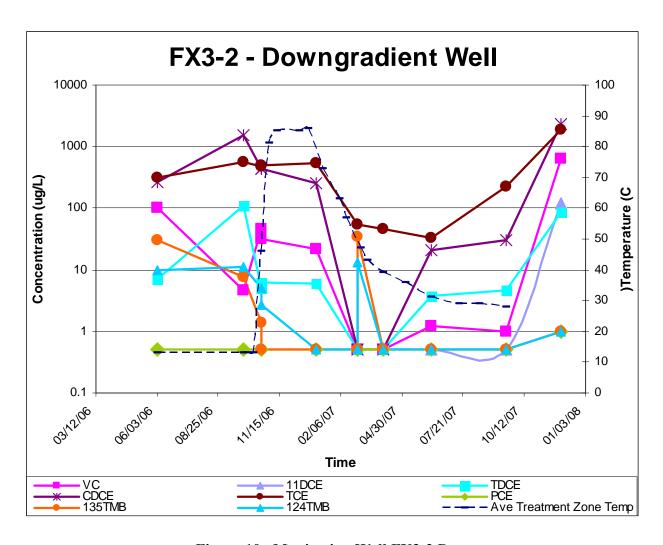


Figure 10. Monitoring Well FX3-2 Data

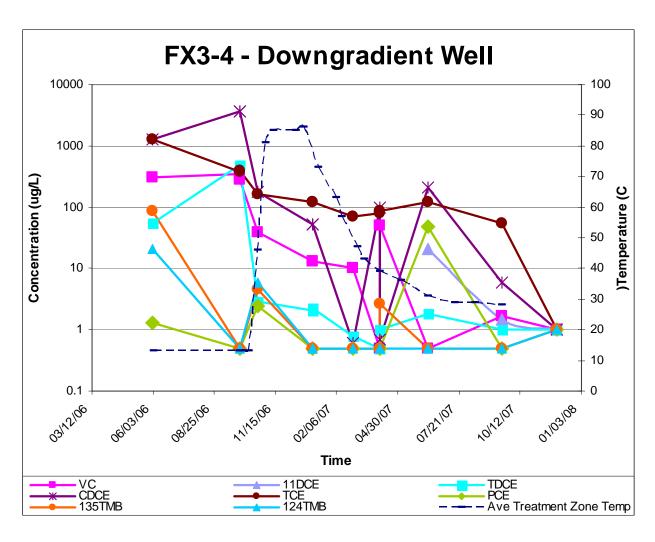


Figure 11. Monitoring Well FX3-4 Data

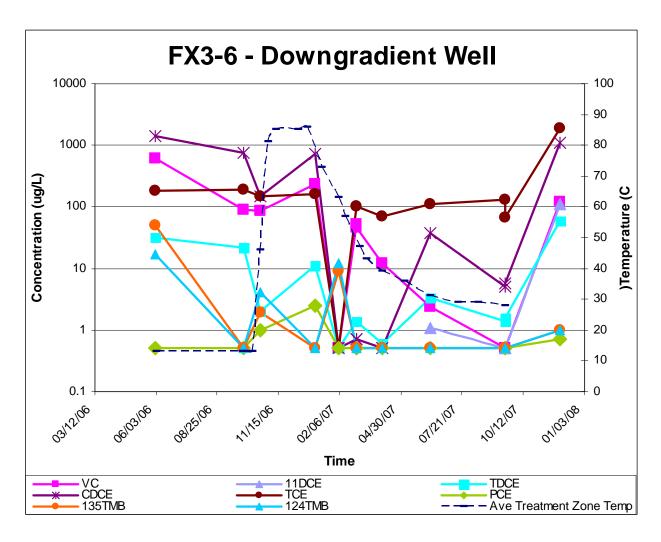


Figure 12. Monitoring Well FX3-6 Data

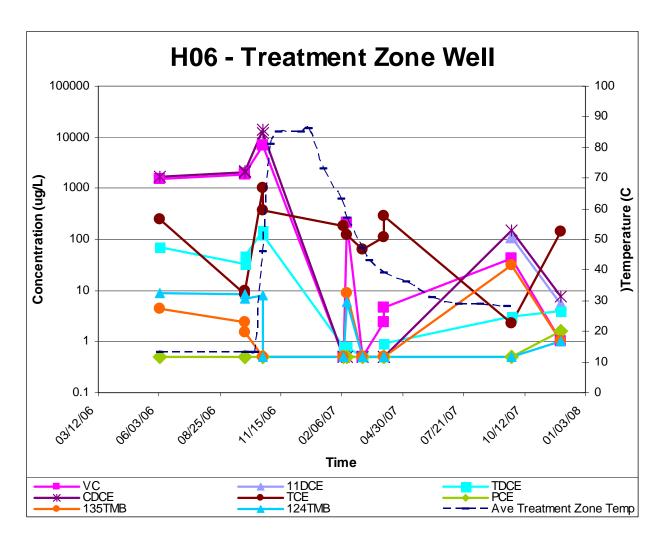


Figure 13. Monitoring Well H06 Data

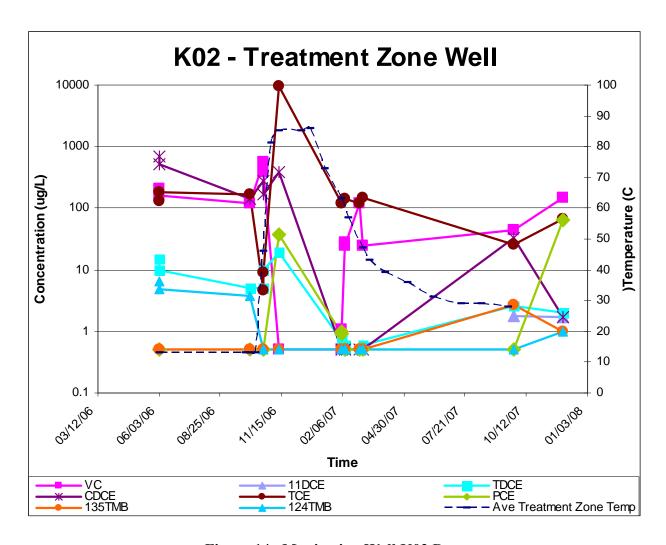


Figure 14. Monitoring Well K02 Data

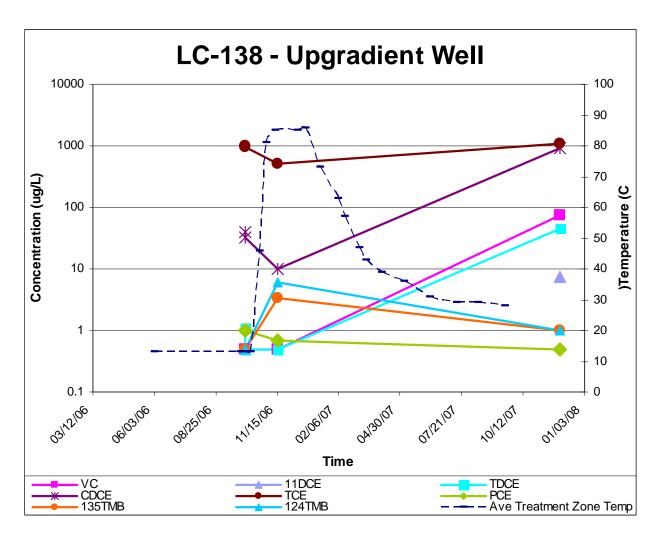


Figure 15. Monitoring Well LC-138 Data

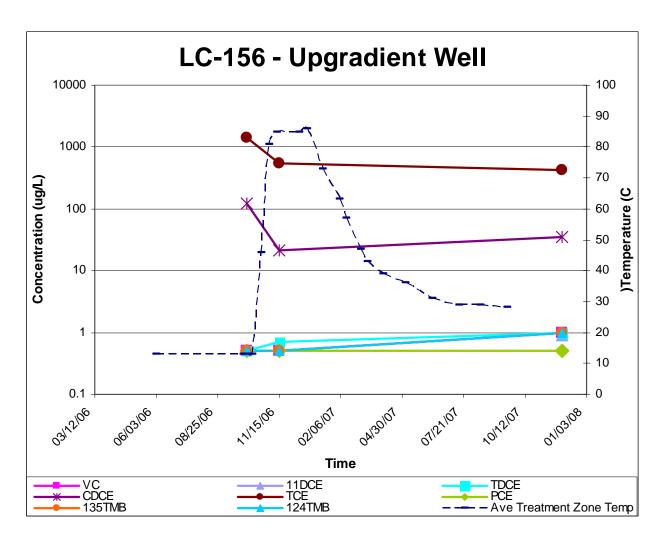


Figure 16. Monitoring Well LC-156 Data

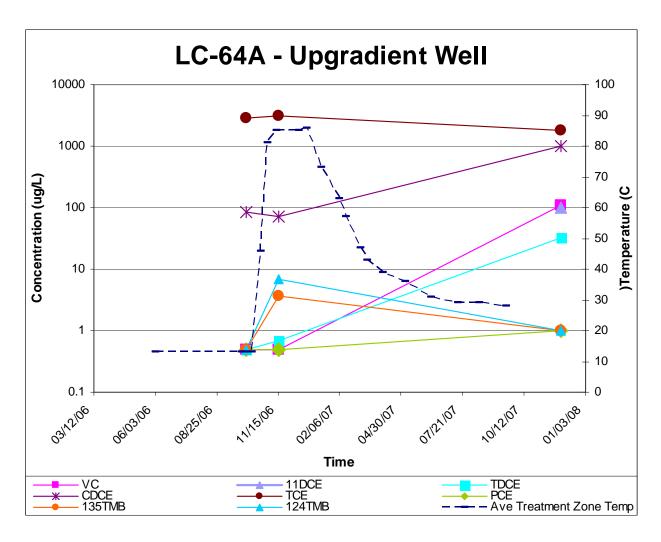


Figure 17. Monitoring Well LC-64A Data

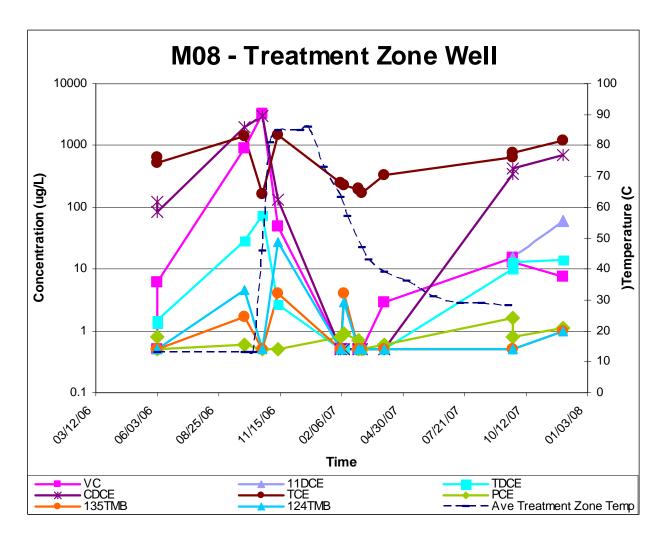


Figure 18. Monitoring Well M08 Data

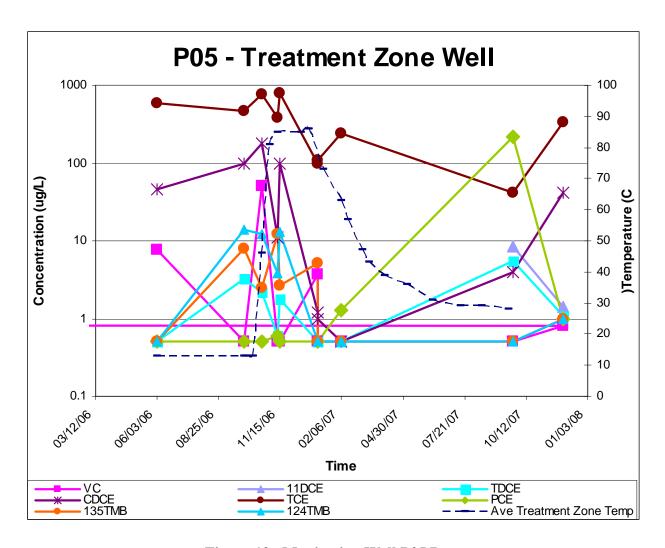


Figure 19. Monitoring Well P05 Data

Tables

Table 1. Groundwater Sampling Locations

Groundwater Monitoring Well or Direct Push Sampling Location	Water Quality Assessment Chlorinated Solvent and Petroleum Hydrocarbon Analysis
C07	Yes
E03	Yes
E10	Yes
F06	Yes
FX3-1	Yes
FX3-12	Yes
FX3-13	Yes
FX3-2	Yes
FX3-4	Yes
FX3-5	Yes
H06	Yes
K02	Yes
LC-138	Yes
LC-156	Yes
LC-64A	Yes
M08	Yes
P05	Yes

Table 2. Groundwater Monitoring Well Analytical Data

				Con	centration	(μg/L)			
Monitoring Well	Date Analyzed	Vinyl Chloride	1,1 DCE	trans-1,2 DCE	cis-1,2 DCE	TCE	PCE	1,3,5 TMB	1,2,4 TMB
C07	6/4/06	950	N/A	170	22000	17000	<1	<1	22
C07	6/4/06	790	N/A	160	20000	16000	<1	<1	15
C07	9/28/06	2100	N/A	150	13000	3300	<1	6	20
C07	10/23/06	1600	N/A	100	9600	2300	<1	<1	<1
C07	3/6/07	13	N/A	5	<1	150	<1	<1	<1
C07	4/5/07	18	N/A	4	<1	150	<1	<1	9
C07 DUP	4/5/07	17	N/A	4	<1	130	150	<1	<1
C07	6/9/07	14	4	6	35	40	<1	<1	<1
C07	9/25/07	72	18	30	720	2200	<1	12	<1
C07	12/1/07	<1	<1	2	93	1500	2	<1	<1
E03	6/4/06	1500	N/A	190	25000	12000	9	3	9
E03	10/2/06	870	N/A	82	5100	1400	<1	<1	<1
E03	10/2/06	850	N/A	91	5300	1400	<1	<1	<1
E03	10/23/06	1300	N/A	150	4500	2500	<1	3	13
E03	11/13/06	390	N/A	110	2800	14000	43	<1	<1
E03	2/5/07	4	N/A	<1	<1	74	<1	<1	<1
E03 DUP	2/5/07	3	N/A	<1	<1	74	<1	<1	<1
E03	2/14/07	150	N/A	2	<1	110	<1	<1	<1
E03	3/6/07	310	N/A	1	<1	140	<1	<1	<1
E03	3/15/07	9	N/A	<1	<1	150	<1	<1	<1
E03	6/9/07	45	2	18	670	110	<1	<1	<1
E03	9/25/07	170	24	38	2200	1000	<1	<1	<1
E03	12/1/07	7	2	39	320	650	2	<1	<1
E10	6/4/06	3600	N/A	110	30000	92	<1	7	12
E10	10/2/06	1300	N/A	34	3200	720	<1	<1	<1
E10 REP	10/2/06	1300	N/A	50	3100	700	<1	<1	<1
E10	10/23/06	320	N/A	12	1100	790	<1	<1	5
E10	11/13/06	19	N/A	8	250	530	<1	<1	<1
E10 DUP	11/13/06	16	N/A	8	230	500	<1	<1	<1
E10	1/5/07	1	N/A	3	140	190	<1	6	<1
E10	2/5/07	<1	N/A	1	<1	110	<1	<1	<1
E10	3/1/07	160	N/A	2	<1	530	<1	<1	<1
E10	3/6/07	5	N/A	2	200	240	<1	<1	<1

Table 2 Continued. Groundwater Monitoring Well Analytical Data

					Concentra	ation (µg/	L)		
Monitoring Well	Date Analyzed	Vinyl Chloride	1,1- DCE	trans- 1,2- DCE	cis-1,2- DCE	TCE	PCE	1,3,5- TMB	1,2,4- TMB
E10	4/5/07	5	N/A	2	1	330	<1	<1	<1
E10	9/25/07	36	15	16	150	200	<1	19	<1
E10	12/1/07	1	87	21	23	610	1100	<1	<1
F06	6/4/06	3400	N/A	280	4600	710	<1	5	19
F06 REP	6/4/06	5800	N/A	280	8000	1200	<1	4	22
F06	10/2/06	4400	N/A	160	14000	240	<1	<1	<1
F06	10/23/06	6700	N/A	100	9600	110	<1	<1	<1
F06	3/6/07	230	N/A	7	100	240	<1	<1	<1
F06	3/15/07	44	N/A	4	<1	180	<1	<1	<1
F06	6/9/07	6	2	3	24	39	<1	<1	<1
F06	9/25/07	39	6	9	130	110	<1	<1	<1
F06	11/30/07	120	24	12	220	200	<1	<1	<1
FX3-1	6/3/06	67	N/A	41	1100	880	<1	81	12
FX3-1	10/23/06	200	N/A	73	2400	950	<1	<1	<1
FX3-1	1/5/07	1	N/A	1	46	96	<1	<1	<1
FX3-1	3/1/07	2	N/A	<1	<1	57	<1	<1	<1
FX3-1	4/5/07	0	N/A	<1	<1	41	<1	<1	<1
FX3-1	6/9/07	2	<1	4	27	30	<1	<1	<1
FX3-1	9/18/07	4	<1	<1	7	52	<1	<1	<1
FX3-1	12/1/07	91	1	12	240	360	1	<1	<1
FX3-12	6/4/06	<1	N/A	<1	5	130	<1	2	2
FX3-12 DUP	6/4/06	<1	N/A	<1	5	120	<1	<1	2
FX3-12	9/29/06	390	N/A	23	800	610	<1	2	6
FX3-12	9/29/06	<1	N/A	180	3700	630	<1	<1	<1
FX3-12	10/23/06	900	N/A	7	1000	390	<1	<1	<1
FX3-12	11/13/06	<1	N/A	<1	28	390	<1	<1	<1
FX3-12	11/16/06	23	N/A	2	140	750	<1	3	10
FX3-12 DUP	11/16/06	30	N/A	3	150	810	<1	<1	<1
FX3-12	2/9/07	<1	N/A	<1	<1	590	2	4	4
FX3-12	12/1/07	25	6	61	1000	780	2	<1	<1
FX3-13	6/4/06	<1	N/A	<1	10	120	<1	11	3

Table 2 Continued. Groundwater Monitoring Well Analytical Data

					Concentra	ation (µg/]	L)		
Monitoring Well	Date Analyzed	Vinyl Chloride	1,1- DCE	trans- 1,2- DCE	cis-1,2- DCE	TCE	PCE	1,3,5- TMB	1,2,4- TMB
FX3-13	10/4/06	<1	N/A	2	4	220	<1	<1	3
FX3-13	10/4/06	<1	N/A	1	4	92	<1	10	19
FX3-13	10/23/06	<1	N/A	<1	2	140	<1	<1	<1
FX3-13	11/13/06	<1	N/A	<1	1	100	<1	<1	<1
FX3-13 REP	11/13/06	<1	N/A	<1	1	110	<1	<1	<1
FX3-13	11/16/06	<1	N/A	<1	3	150	<1	4	5
FX3-13	2/9/07	<1	N/A	<1	<1	98	<1	3	8
FX3-13	12/1/07	160	66	41	920	1500	<1	<1	<1
FX3-13 DUP	12/1/07	3	1	3	130	1200	3	<1	<1
FX3-2	6/4/06	100	N/A	7	270	320	<1	30	10
FX3-2	9/28/06	5	N/A	110	1500	570	<1	8	11
FX3-2	10/23/06	46	N/A	5	440	470	<1	1	5
FX3-2 DUP	10/23/06	32	N/A	6	440	500	<1	<1	3
FX3-2	1/5/07	22	N/A	6	250	530	<1	<1	<1
FX3-2	3/1/07	<1	N/A	<1	<1	55	<1	<1	<1
FX3-2 REP	3/1/07	<1	N/A	<1	<1	55	<1	35	13
FX3-2	4/5/07	<1	N/A	<1	<1	46	<1	<1	<1
FX3-2	6/9/07	1	<1	4	21	33	<1	<1	<1
FX3-2	9/18/07	1	<1	5	30	220	<1	<1	<1
FX3-2	12/1/07	650	120	87	2300	1900	<1	<1	<1
FX3-4	6/3/06	310	N/A	55	1300	1300	1	88	21
FX3-4	9/29/06	340	N/A	480	3600	380	<1	<1	<1
FX3-4 REP	9/29/06	280	N/A	480	3600	390	<1	<1	<1
FX3-4	10/23/06	39	N/A	3	180	160	2	5	6
FX3-4	1/5/07	13	N/A	2	52	120	<1	<1	<1
FX3-4 REP	1/5/07	13	N/A	2	53	120	<1	<1	<1
FX3-4	3/1/07	10	N/A	<1	<1	70	<1	<1	<1
FX3-4	4/5/07	<1	N/A	<1	100	80	<1	<1	<1
FX3-4 REP	4/5/07	50	N/A	1	<1	87	<1	3	<1
FX3-4	6/9/07	<1	21	2	210	120	48	<1	<1
FX3-4	9/18/07	2	2	1	6	55	<1	<1	<1

Table 2 Continued. Groundwater Monitoring Well Analytical Data

					Concentra	ation (μg/	L)		
Monitoring Well	Date Analyzed	Vinyl Chloride	1,1- DCE	trans- 1,2- DCE	cis-1,2- DCE	TCE	PCE	1,3,5- TMB	1,2,4- TMB
FX3-4	12/1/07	<1	<1	<1	<1	<1	<1	<1	<1
FX3-6	6/3/06	600	N/A	32	1400	180	<1	51	17
FX3-6	9/29/06	91	N/A	22	740	190	<1	<1	<1
FX3-6	10/23/06	87	N/A	2	150	150	1	2	4
FX3-6	1/5/07	230	N/A	11	710	160	3	<1	<1
FX3-6	2/5/07	<1	N/A	<1	<1	<1	<1	9	12
FX3-6	3/1/07	52	N/A	1	<1	100	<1	<1	<1
FX3-6 DUP	3/1/07	47	N/A	1	<1	100	<1	<1	<1
FX3-6	4/5/07	12	N/A	<1	<1	71	<1	<1	<1
FX3-6	6/9/07	2	1	3	37	110	<1	<1	<1
FX3-6	9/18/07	<1	<1	1	5	130	<1	<1	<1
FX3-6 DUP	9/18/07	<1	<1	2	6	68	<1	<1	<1
FX3-6	12/1/07	120	110	59	1100	1900	1	<1	<1
H06	6/4/06	1500	N/A	72	1700	250	<1	4	9
H06	9/28/06	1900	N/A	33	2100	9	<1	2	8
H06 DUP	9/28/06	2000	N/A	46	2200	10	<1	2	7
H06	10/23/06	6800	N/A	150	14000	1000	<1	<1	8
H06 DUP	10/23/06	7000	N/A	120	12000	380	<1	<1	<1
H06	2/9/07	<1	N/A	<1	<1	180	<1	<1	<1
H06	2/14/07	210	N/A	<1	<1	120	<1	9	6
H06	3/6/07	<1	N/A	<1	<1	63	<1	<1	<1
H06	4/4/07	2	N/A	<1	<1	110	<1	<1	<1
H06 DUP	4/4/07	5	N/A	<1	<1	290	<1	<1	<1
H06	9/25/07	43	110	3	150	2	<1	32	<1
H06	11/30/07	<1	5	4	8	140	2	<1	<1
K02	6/4/06	210	N/A	15	680	130	<1	<1	6
K02 REP	6/4/06	160	N/A	10	510	180	<1	<1	5
K02	10/4/06	120	N/A	5	140	170	<1	<1	4
K02	10/23/06	560	N/A	5	280	5	<1	<1	<1
K02	10/23/06	380	N/A	10	170	9	<1	<1	<1
K02	11/13/06	<1	N/A	19	390	9500	38	<1	<1

Table 2 Continued. Groundwater Monitoring Well Analytical Data

					Concentra	ation (μg/	L)		
Monitoring Well	Date Analyzed	Vinyl Chloride	1,1- DCE	trans- 1,2- DCE	cis-1,2- DCE	TCE	PCE	1,3,5- TMB	1,2,4- TMB
K02	2/5/07	<1	N/A	<1	<1	120	<1	<1	<1
K02 DUP	2/5/07	1	N/A	<1	<1	120	1	<1	<1
K02	2/9/07	28	N/A	<1	<1	140	<1	<1	<1
K02 DUP	2/9/07	25	N/A	<1	<1	140	<1	<1	<1
K02	3/1/07	120	N/A	<1	<1	120	<1	<1	<1
K02	3/6/07	25	N/A	<1	<1	150	<1	<1	<1
K02	9/25/07	44	2	3	33	26	<1	3	<1
K02	11/30/07	150	2	2	2	66	65	<1	<1
LC-138	10/4/06	<1	N/A	1	39	1000	1	<1	<1
LC-138 DUP	10/4/06	<1	N/A	<1	32	970	1	<1	<1
LC-138	11/16/06	<1	N/A	<1	10	520	<1	3	6
LC-138	12/1/07	75	8	46	930	1100	1	<1	<1
LC-156	10/4/06	<1	N/A	<1	120	1400	<1	<1	<1
LC-156	11/16/06	<1	N/A	<1	21	550	<1	<1	<1
LC-156	11/30/07	<1	1	1	35	430	1	<1	<1
LC-64A	10/4/06	<1	N/A	<1	84	2900	<1	<1	<1
LC-64A	11/16/06	<1	N/A	<1	73	3100	<1	4	7
LC-64A	12/1/07	110	100	32	990	1800	<1	<1	<1
M08	6/4/06	<1	N/A	1	120	640	<1	<1	<1
M08 DUP	6/4/06	6	N/A	2	85	530	<1	<1	<1
M08	9/28/06	890	N/A	29	2000	1400	<1	2	5
M08	10/23/06	3300	N/A	73	3000	160	<1	<1	<1
M08	11/13/06	49	N/A	3	130	1500	<1	4	27
M08	2/5/07	<1	N/A	<1	<1	250	<1	<1	<1
M08	2/9/07	<1	N/A	<1	<1	230	<1	4	3
M08	3/1/07	<1	N/A	<1	<1	190	<1	<1	<1
M08 DUP	3/1/07	<1	N/A	<1	<1	200	<1	<1	<1
M08	3/6/07	<1	N/A	<1	<1	170	<1	<1	<1
M08	4/4/07	3	N/A	<1	<1	330	<1	<1	<1
M08	9/25/07	15	14	10	340	650	2	<1	<1
M08 DUP	9/25/07	13	15	13	420	760	<1	<1	<1

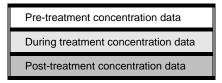
Table 2 Continued. Groundwater Monitoring Well Analytical Data

					Concentra	ation (µg/	L)		
Monitoring Well	Date Analyzed	Vinyl Chloride	1,1- DCE	trans- 1,2- DCE	cis-1,2- DCE	TCE	PCE	1,3,5- TMB	1,2,4- TMB
M08	12/1/07	8	59	14	690	1200	1	<1	<1
P05	6/4/06	<1	N/A	<1	46	580	<1	<1	<1
P05	9/28/06	51	N/A	3	100	470	<1	8	14
P05	10/23/06	<1	N/A	2	180	770	<1	3	12
P05	11/13/06	<1	N/A	<1	11	380	<1	12	4
P05	11/16/06	4	N/A	2	100	790	<1	3	13
P05	1/5/07	<1	N/A	<1	1	97	<1	5	<1
P05 DUP	1/5/07	<1	N/A	<1	1	110	<1	<1	<1
P05	2/5/07	<1	N/A	<1	<1	240	1	<1	<1
P05	9/25/07	<1	8	6	170	700	220	7	<1
P05	12/1/07	<1	1	1	42	330	<1	<1	<1
TB 01	6/4/06	1	N/A	2	2	3	3	4	9
TB 01	6/4/06	26	N/A	2	2	2	2	3	8
TB 02	6/4/06	<1	N/A	<1	<1	<1	<1	<1	2
TB 03	6/4/06	<1	N/A	<1	<1	<1	<1	<1	2
TB 01	10/2/06	<1	N/A	<1	<1	<1	<1	<1	<1
TB 02	10/4/06	<1	N/A	<1	<1	<1	<1	<1	<1
TB01	10/23/06	<1	N/A	<1	<1	<1	<1	5	9
TB01	11/13/06	<1	N/A	<1	<1	<1	<1	5	17
TB01	11/16/06	<1	N/A	<1	<1	<1	<1	<1	25
ТВ	1/5/07	<1	N/A	<1	<1	<1	<1	<1	<1
ТВ	1/5/07	<1	N/A	<1	<1	<1	<1	<1	<1
TB01	2/9/07	<1	N/A	<1	<1	<1	<1	<1	<1
TB02	2/9/07	<1	N/A	<1	<1	<1	<1	9	9
ТВ	2/14/07	<1	N/A	<1	<1	<1	<1	<1	<1
TB01	3/1/07	<1	N/A	<1	<1	<1	<1	<1	<1
ТВ	3/6/07	<1	N/A	<1	<1	<1	<1	<1	<1
ТВ	3/6/07	<1	N/A	<1	<1	<1	<1	<1	<1
ТВ	3/15/07	<1	N/A	<1	<1	<1	<1	<1	<1
ТВ	4/4/07	<1	N/A	<1	<1	<1	<1	<1	<1
ТВ	4/5/07	<1	N/A	<1	<1	<1	<1	<1	<1

Table 2 Continued. Groundwater Monitoring Well Analytical Data

				Concentration (µg/L)					
Monitoring Well	Date Analyzed	Vinyl Chloride	1,1- DCE	trans- 1,2- DCE	cis-1,2- DCE	TCE	PCE	1,3,5- TMB	1,2,4- TMB
ТВ	9/18/07	<1	<1	<1	<1	<1	<1	<1	<1
TB01	9/25/07	<1	<1	<1	<1	<1	<1	<1	<1
TB02	9/25/07	<1	<1	<1	<1	<1	<1	<1	<1
ТВ	12/1/07	73	36	13	470	430	<1	<1	<1

Notes:



DUP - Duplicate sample, REP - Quality control sample (second analysis of same water sample), N/A - Contaminant not analyzed for Non-detect parameters are reported as less than the detection limit (<1 μ g/L), TB - Trip blank DCE – Dichloroethene, TCE – Trichloroethene, TMB – Trimethylbenzene, PCE - Tetrachloroethene

Table 3. Groundwater Monitoring Well Water Temperatures

Monitoring Well	Date Analyzed	Pre- treatment Temperature (°C)
C07	6/4/06	13
C07	6/4/06	13
C07	9/28/06	13
E03	6/4/06	13
E03	10/2/06	13
E03	10/2/06	13
E10	6/4/06	11
E10	10/2/06	11
E10 REP	10/2/06	11
F06	6/4/06	13
F06 REP	6/4/06	13
F06	10/2/06	13
FX3-1	6/3/06	14*
FX3-12	6/4/06	14*
FX2-12 DUP	6/4/06	14*
FX3-12	9/29/06	14*
FX3-12	9/29/06	14*
FX3-13	6/4/06	14*
FX3-13	10/4/06	14*
FX3-13	10/4/06	14*
FX3-2	6/4/06	14*
FX3-2	9/28/06	15
FX3-4	6/3/06	14*
FX3-4	9/29/06	14
FX3-4 REP	9/29/06	14
FX3-6	6/3/06	14*
FX3-6	9/29/06	15
H06	6/4/06	15
H06	9/28/06	15
H06 DUP	9/28/06	15
K02	6/4/06	12
K02 REP	6/4/06	12
K02	10/4/06	12
LC-138	10/4/06	14*
LC-138 DUP	10/4/06	14*
LC-156	10/4/06	14*
LC-64A	10/4/06	14*
M08	6/4/06	14
M08	9/28/06	15
M08 DUP	6/4/06	14
P05	6/4/06	13
P05	9/28/06	13
TB 01	6/4/06	
TB 01	6/4/06	
TB 02	6/4/06	
TB 03	6/4/06	
TB 01	10/2/06	
TB 02	10/4/06	

Monitoring Well	Date Analyzed	During Treatment Temperature (°C)
C07	10/23/06	47
E03	10/23/06	45
E03	11/13/06	71
E10	10/23/06	37
E10	11/13/06	92
E10 DUP	11/13/06	92
E10	1/5/07	51
F06	10/23/06	50
FX3-1	10/23/06	14
FX3-1	1/5/07	18
FX3-12	10/23/06	14*
FX3-12	11/13/06	14*
FX3-12	11/16/06	14*
FX3-12 DUP	11/16/06	14*
FX3-13	10/23/06	14*
FX3-13	11/13/06	14*
FX3-13 REP	11/13/06	14*
FX3-13	11/16/06	14*
FX3-2	10/23/06	13
FX3-2 DUP	10/23/06	13
FX3-2	1/5/07	12
FX3-4	10/23/06	13
FX3-4	1/5/07	14*
FX3-4 REP	1/5/07	14*
FX3-6	10/23/06	14
FX3-6	1/5/07	16
H06	10/23/06	66
H06 DUP	10/23/06	66
K02	10/23/06	51
K02	10/23/06	51
K02	11/13/06	80
LC-138	11/16/06	14*
LC-156	11/16/06	14*
LC64A	11/16/06	14*
M08	10/23/06	40
M08	11/13/06	79
P05	10/23/06	30
P05	11/13/06	79
P05	11/16/06	80
P05	1/5/07	57
P05 DUP	1/5/07	57
TB01	10/23/06	
TB01	11/13/06	
TB01	11/16/06	
TB	1/5/07	
TB	1/5/07	

Note:
-- No temperature data taken

^{*} Temperature data estimated based on background temperature because wells were not in the treatment zone

Table 3. Groundwater Monitoring Well Water Temperatures (Continued)

Monitoring Well	Date Analyzed	Post-Treatment Temperature (°C)
C07	3/6/07	76
C07	4/5/07	70
C07 DUP	4/5/07	70
C07	6/9/07	58
C07	9/25/07	43
E03	2/5/07	66
E03 DUP	2/5/07	66
E03	2/14/07	61
E03	3/6/07	53
E03	3/15/07	49
E03	6/9/07	37
E03	9/25/07	33
E10	2/5/07	75
E10	3/1/07	44
E10	3/6/07	57
E10	4/5/07	46
E10	9/25/07	40
F06	3/6/07	75
F06	3/15/07	67
F06	6/9/07	35
F06	9/25/07	36
FX3-1	3/1/07	11
FX3-1	4/5/07	11
FX3-1	6/9/07	14*
FX3-1	9/18/07	14*
FX3-12	2/9/07	14*
FX3-13	2/9/07	14*
FX3-2	3/1/07	9
FX3-2 REP	3/1/07	9
FX3-2	4/5/07	10
FX3-2	6/9/07	14*
FX3-2	9/18/07	14*
FX3-4	3/1/07	15
FX3-4	4/5/07	14
FX3-4 REP	4/5/07	14
FX3-4	6/9/07	14*
FX3-4	9/18/07	14*
FX3-6	2/5/07	14*
FX3-6	3/1/07	22
FX3-6 DUP	3/1/07	22
FX3-6	4/5/07	19
FX3-6	6/9/07	14*
FX3-6	9/18/07	14*
FX3-6 DUP	9/18/07	14*
H06	2/9/07	67
H06	2/14/07	58
H06	3/6/07	47
H06	4/4/07	39
H06 DUP	4/4/07	39
H06	9/25/07	20

Monitoring Well	Date Analyzed	Post- Treatment Temperature (°C)
K02	2/5/07	42
K02 DUP	2/5/07	42
K02	2/9/07	37
K02 DUP	2/9/07	37
K02	3/1/07	27
K02	3/6/07	26
K02	9/25/07	20
M08	2/5/07	53
M08	2/9/07	51
M08	3/1/07	34
M08 DUP	3/1/07	34
M08	3/6/07	32
M08	4/4/07	22
M08	9/25/07	14
M08 DUP	9/25/07	14
P05	2/5/07	12
P05	9/25/07	14
TB01	2/9/07	
TB02	2/9/07	
TB	2/14/07	
TB01	3/1/07	
TB	3/6/07	
TB	3/6/07	
TB	3/15/07	
TB	4/4/07	
TB	4/5/07	
TB	9/18/07	
TB01	9/25/07	
TB02	9/25/07	

Note:

⁻⁻ No temperature data taken

^{*} Temperature data estimated based on background temperature because wells were not in the treatment zone

Table 4. Groundwater Treatment Zone Average Water Temperature

Date	Temperature (C)
6/4/06	13
9/28/06	13
10/2/06	13
10/11/06	13
10/23/06	46
11/2/06	81
11/13/06	85
12/13/06	85
12/24/06	86
1/13/07	73
2/5/07	63
2/14/07	57
3/6/07	47
3/15/07	43
4/5/07	39
5/5/07	36
6/9/07	31
7/16/07	29
8/13/07	29
9/18/07	28

Table 5. Mass Flux Analysis

Hydraulic conductivity (ft/day)	Hydraulic Gradient (ft/ft)	Hydraulic Conductivity and Gradient Measurements	Discharge (kg/yr)
38	0.0012	Low hydraulic conductivity and gradient	1.42E-01
38	0.0027	Low hydraulic conductivity and average gradient	3.20E-01
65	0.0027	Average hydraulic conductivity and gradient	5.47E-01
65	0.0034	Average hydraulic conductivity and middle of average and high gradient	6.89E-01
120	0.0042	High hydraulic conductivity and gradient	1.57E+00

Appendix E

Quality Assurance Project Plan (see electronic attachment)

ER-0314 Appendix E

APPENDIX E

QUALITY ASSURANCE PROJECT PLAN

(Reproduced here from the Demonstration Plan)

E1.0 Purpose and Scope of Plan

This Quality Assurance Project Plan (QAPP) establishes the quality assurance guidelines to be utilized during this project. This QAPP has been developed to address the DoD requirements for precision, accuracy, representativeness, completeness, and comparability of data collected and generated during this demonstration. The QAPP also provides the quality assurance requirements for data handling, manipulation, and reporting. It has been designed to ensure the quality of the data gathered and generated, as well as the conclusions and recommendations reached from the use of the data.

E2.0 Quality Assurance Responsibilities

Dr. Paul C. Johnson will be responsible for ensuring that the data collection activities conform to this QAPP. ASU will conduct the analysis of groundwater samples in the field with a laboratory-quality GC (SRI Model 3610C or equivalent). The ASU field laboratory will establish data quality objectives similar to those outlined below.

The quality assurance activities incorporated in the project will be used to maintain the accuracy and the precision of the system demonstration and the field analytical techniques. These activities include frequent equipment calibration, field blank samples (for shipment to the analytical laboratory), and field laboratory sample blanks. The quality assurance activities are designed to trigger corrective action activities and diagnose potential sources of error.

ASU will be responsible for summarizing the laboratory data and for data reduction and technology evaluation. Dr. Paul Johnson will be responsible for reviewing analytical data, identifying any deviations from the established protocols and data quality objectives, and then deciding how the data will be used, and what corrections, if any, need to be made to the field analytical procedures.

E3.0 Project Objectives

The objectives of this demonstration are summarized below:

Performance		Primary or
Criteria	Description	Secondary
Data set collected	Data set to include aquifer characterization data and	Primary
provides useful	contaminant concentration along a transect perpendicular	
supplemental	to groundwater flow.	
post-treatment		
data on water		
quality and mass		
discharge		

This QAPP focuses on the in-field data collection activities.

E4.0 Experimental Measurements

The following section describes measurements to be made during this project; these are divided into categories focused on water quality changes and system hydraulic measurements.

E4.1 Groundwater Quality Measurement

Groundwater will be assessed for dissolved oxygen and concentrations of chemicals of interest (site-specific).

General Water Quality Parameters: General water quality parameters pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP) will be measured using a flow-through system composed of a meter (Horiba U-22 or similar), a flow-through cell, and a variable-speed slow-flow peristaltic pump. Water quality measurements will be monitored until a stable reading is obtained and until a sufficient volume of water from the well or groundwater sampling point is purged (volume will vary depending on the depth of the depth-discrete sample).

<u>Dissolved Oxygen:</u> In lieu of more detailed general water quality assessments, DO concentrations will be measured using a flow-through system composed of a DO meter (YSI Model 550A Oxygen Probe or similar), a flow-through cell, and a variable-speed slow-flow peristaltic pump. DO concentrations will be monitored until a stable reading is obtained and until a sufficient volume of water from the well or groundwater sampling point is purged (volume will vary depending on the depth of the depth-discrete sample).

<u>Dissolved Chemicals of Interest:</u> Groundwater samples will be collected using the low-flow variable-speed peristaltic pump discussed above. After water quality parameters have been collected and an appropriate volume of water has been purged from the sampling interval, a sample will be collected in a 40-mL VOA vial with a septa-lined cap. Groundwater samples will be analyzed in the field for concentrations of chemicals of interest. Samples measured in the field will be analyzed using a headspace GC method. The GC used will be an SRI Series 8610C

or similar equipped with a FID, PID, and/or an DELCD detectors. The GC will be calibrated to known dissolved concentrations of these analytes.

E4.2 System Hydraulics Measurements

The following measurements relate to better understanding the groundwater flow system at the time of sampling:

<u>Depth to groundwater:</u> The depth to groundwater will be measured with a standard electronic interface probe. For example, typical devices are comprised of an electronic sensor attached to the end of a 50- to 200-ft measuring tape marked with 0.01-ft increments.

Aquifer Characterization Tests: Specific capacity pump tests will be conducted as follows: a) an interface probe will locate the static water level in a small-diameter Geoprobe drive rod, b) tubing will be lowered so that the tubing intake is located a known distance below the static water level, c) a peristaltic pump will be operated at full speed with the hope that the pump rate is faster than the recharge rate to the well, so that the draw-down becomes the depth to the tubing intake, d) the flow rate is measured by the standard bucket-and-stopwatch approach, and e) the data is analyzed to determine hydraulic conductivity.

Slug tests will be conducted in conventional wells using a data logging pressure transducer and a slug capable of displacing about 2-ft of water. The slug is either lowered into, or pulled out of the well, and the water level response is monitored until it stabilizes at the pre-test level. The data is then analyzed by standard slug-test analysis methods.

Laboratory permeameter tests will be conducted using the constant-head technique whereby the flow through a vertical column is measured under conditions of a constant pre-set hydraulic head. The flow is measured by recording the time it takes to fill a 2-L volumetric flask and then the hydraulic conductivity is determined from the known column geometry, pre-set head, and measured flowrate.

E4.3 Sample Collection Techniques

Groundwater samples will be collected in a manner consistent with site conditions.

In most cases, groundwater samples will be collected using a variable-speed low-flow peristaltic pump and collected in a 40-mL VOA vial with a septa-lined cap. Analyses will be conducted in the field within 24-hours. In some cases it may be necessary to collect samples using bailers or down-hole pumps.

All sample collection devices will be cleaned and prepared in accordance to applicable USEPA procedures prior to each use.

E4.4 Sample Identification Procedures

Each sample will be identified with a unique sample number coded to correlate to the sampling location and depth assigned by the sample collector at the time of collection. This code will be

logged onto a master field data sheet indicating who collected the sample, where the sample was collected, and the date of sample collection.

Each sample will be logged in the Project Record Book (see section on Documentation) with the information recorded on the sample container label and a brief sample description. Any samples being shipped off-site for analysis will be logged on a chain-of-custody log sheet to be sent with the samples to document sample receipt.

E5.0 Data Quality Parameters

Precision will be based on the relative percent difference (RPD) of duplicate analysis of samples. Accuracy will be determined by the percentage of analyte recovered (percent recovery [%R]) from sample of known concentration. Laboratory QC will consist of analytical duplicates conducted for 10% of the total samples submitted for analysis. One laboratory control sample will be included for each 20 samples to ensure that the analytical equipment is operating properly. Laboratory controls will consist of standards of known concentrations. The calculation for each of these quantitative objectives is described in the following sections.

<u>Accuracy:</u> The percent accuracy is calculated from the general equation:

% Accuracy =
$$\frac{100 \left(X - X_a\right)}{X_a}$$
 (B-1)

where

X is the parameter measured X_a is the parameter's known value

The accuracy claimed by each field instrument manufacturer will be compared with the percent accuracy as measured from standard samples. If the percent accuracy is less than the required accuracy then corrective action will be initiated.

<u>Precision:</u> Precision for the field laboratory analytical procedures will be assessed by the analytical laboratory on an on-going basis. ASU (Dr. Johnson) will review all analytical data to ensure that any questions concerning data validity are addressed at the earliest time possible.

<u>Completeness</u>: Percent completeness is defined by the general equation:

% Completeness =
$$100 \frac{D_o}{D_S}$$
 (B-2)

where $D_o = quantity of data obtained$

 D_s = quantity of data scheduled to be obtained

Completeness in meeting the scheduled data recovery objectives will increase throughout the project as the experience base in equipment operation characteristics increases. The completeness objective for operations during this study is 90% for each test parameter.

E6.0 Calibration Checks, Quality Control Checks, and Corrective Actions

All GC-FID/PID/DELCD analyses will be conducted on a dedicated SRI Instruments Model 8610C gas chromatograph using a DB-1 type capillary column. The instrument will be calibrated each day at at least three different concentrations spanning the concentration range of interest (e.g. 10, 100, 1000 μ g/L for dissolved concentrations of chemicals of interest). In addition, at least one calibration sample is re-analyzed approximately two – to four-times during the day to detect any instrument drift. If area counts from successive calibration analyses consistently deviate by more than 20%, or if retention times vary by more than 0.20 minutes, then the following routine checks are made to the equipment: a) leaking septum and b) change in gas flows. If these prove not to be the source of error, then a new standard is made and analyzed. If necessary, recalibration over the entire concentration range is repeated. Reporting levels will be established based on the calibration results. Based on experience with this instrument, reporting levels of about $1-5~\mu$ g/L are possible for typical chemicals of interest in groundwater.

Water quality meters are calibrated according to the manufacturer's specification.

YSI DO meters are calibrated in air, at ambient temperature, according to the manufacturer's specification.

The specific nature of all corrective actions and the operating limits that would trigger the need for corrective action for all aspects of the remediation system and analytical operations are to numerous to anticipate here. Most corrective actions will be empirical in nature as the following specific examples show.

Problem

Analysis of standard sample indicated field GC accuracy has drifted outside established limits (calibration check every 20 samples).

Problem

DO/WQ meter does not calibrate properly, or is providing suspect data.

Corrective Action

Perform replicate standard analysis. Verify instrument parameters Recalibrate instrument.

Corrective Action

Recalibrate and re-test Replace membrane as applicable, recalibrate, and retest

E7.0 Documentation and Record-Keeping

E7.1 Quality Assurance Reports

A chronological record of all field work associated with the project will be maintained in the Project Record Book. The record book will be used to record all activities and relevant observations during the field sampling events.

E7.2 Data Format

A summary of the sampling results for each sampling event will be produced within 30 days of the sampling event. The data will be presented with the following data fields:

- Sampling date
- Sampling time
- Location designation
- Position of sampling location relative to known location
- DO
- Temperature
- Chemical concentration(s)
- Relevant notes for the collection and analysis of that sample

E7.3 Data Storage

All data and reports will be archived in both paper and electronic format. All electronic files will be backed-up on compact disks (CDs) at one-month intervals (minimum). All paper files (e.g., field log books) will be copied and archived in a project-specific file.

APPENDIX F

Uncertainty Analysis for Mass Discharge Calculations

ER-0314 Appendix F

Site Location and I.D.:
Description:

Next Step:

Mass Flux Summary

Back to Mass Flux Result

Back to Data Input

INSTRUCTIONS

1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darcy velocity and gradient input data.

2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

SELECT TRANSECT TO VIEW SELECT TIME PERIOD TO VIEW

Transect 1 ▼ 1

TCE Interpolation Methods

Hydraulic Conductivity: 1) Vertical: Linear 2) Horizontal: Linear Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: 1) Vertical: Linear 2) Horizontal: Linear

Total Mass Flux Including All Points

1.06E+01 (g/day)

Print

HELP

_			1	_			RESU	T	
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)	
1	Start of Transect			Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
2	GP5	29.0	34.0	Conductivity	5.00E-03	ft/d	1.07E+01	-1.5	
3	GP6	29.0	31.0	Conductivity	5.00E-03	ft/d	1.09E+01	-2.8	
4	GP6	31.0	31.5	Conductivity	2.57E+01	ft/d	9.98E+00	5.5	
5	GP6	32.0	32.2	Conductivity	2.57E+01	ft/d	1.06E+01	0.0	
5	GP6	33.0	33.5	Conductivity	2.57E+01	ft/d	1.06E+01	0.0	
7	GP6	29.0	34.0	Conductivity	2.01E+01	ft/d	1.06E+01	0.0	
8	GP11	29.0	31.0	Conductivity	5.00E-03	ft/d	1.14E+01	-7.7	
9	GP11	31.0	35.0	Conductivity	3.98E+01	ft/d	8.64E+00	18.2	
9	GP4	29.0	30.0	Conductivity	5.00E-03	ft/d	1.19E+01	-12.4	
_	GP4						5.98E+00	43.3	
1		30.0	30.5	Conductivity	5.40E+01	ft/d			
2	GP4	31.0	31.5	Conductivity	5.00E-02	ft/d	1.06E+01	0.0	
3	GP4	32.0	32.5	Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
4	GP4	33.0	33.5	Conductivity	5.40E+01	ft/d	1.06E+01	0.0	
5	GP4	34.0	34.5	Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
5	GP4	29.0	34.5	Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
7	GP7	29.0	31.0	Conductivity	5.00E-03	ft/d	1.23E+01	-16.4	
3	GP7	31.0	31.5	Conductivity	1.66E+02	ft/d	7.09E+00	32.8	
9	GP7	32.0	32.5	Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
2	GP7	33.0	33.5	Conductivity	1.66E+02	ft/d	1.06E+01	0.0	
1	GP7	33.8	34.3	Conductivity	4.68E+02	ft/d	1.06E+01	0.0	
2	GP7	29.0	34.3	Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
3	GP3	29.0	32.0	Conductivity	5.00E-03	ft/d	1.06E+01	-0.3	
4	GP3	32.0	32.5	Conductivity	3.50E+01	ft/d	1.05E+01	0.2	
	GP3	33.0	33.5	Conductivity	5.01E+01	ft/d	1.05E+01	0.0	
5	GP3						1.06E+01 1.06E+01	0.0	
5		33.5	34.0	Conductivity	2.64E+01	ft/d			
7 _	GP3	29.0	34.0	Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
3	GP8	29	33.5	Conductivity	5.00E-03	ft/d	1.06E+01	0.0	
9	End of Transect			Conductivity	5.00E-03	ft/d_	1.06E+01	0.0	
)	Start of Transect			Concentration	0.00E+00	ug/L	1.06E+01	0.0	
1	GP5	29	34	Concentration	1.20E+03	ug/L	1.05E+01	0.7	
2	GP6	29	31	Concentration		ug/L	1.06E+01	0.0	
3	GP6	31	31.5	Concentration	7.10E+02	ug/L	1.13E+01	-7.3	
4	GP6	32	32.2	Concentration	5.60E+02	ug/L	1.06E+01	0.0	
5	GP6	33	33.5	Concentration	1.75E+03	ug/L	1.06E+01	0.0	
6	GP6	29	34	Concentration	3.90E+03	ug/L	1.06E+01	0.0	
7	GP11	29	31	Concentration		ug/L	1.06E+01	0.0	
3	GP11	31	35	Concentration	2.90E+03	ug/L	1.02E+01	3.8	
9	GP4	29	30	Concentration	2.002.00	ug/L	1.06E+01	0.0	
5	GP4	30	30.5	Concentration	4.70E+03	ug/L	5.34E+00	49.5	
1	GP4	31	31.5	Concentration	1.50E+03	ug/L	1.06E+01	0.0	
	GP4	32	32.5	Concentration	1.00E+03	ug/L ug/L	1.06E+01 1.06E+01	0.0	
2	GP4 GP4				E 40E: 00		1.06E+01	0.0	
3		33	33.5	Concentration	5.40E+03	ug/L			
4	GP4	34	34.5	Concentration	0.40=	ug/L	1.06E+01	0.0	
5	GP4	29	34.5	Concentration	2.40E+03	ug/L	1.06E+01	0.0	
5	GP7	29	31	Concentration		ug/L	1.06E+01	0.0	
7	GP7	31	31.5	Concentration	1.00E+02	ug/L	2.04E+01	-93.0	
3	GP7	32	32.5	Concentration	1.10E+02	ug/L	1.06E+01	0.0	
9	GP7	33	33.5	Concentration	5.20E+01	ug/L	1.06E+01	0.0	
2	GP7	33.8	34.3	Concentration	3.80E+01	ug/L	1.06E+01	0.0	
1	GP7	29	34.3	Concentration		ug/L	1.06E+01	0.0	
2	GP3	29	32	Concentration		ug/L	1.06E+01	0.0	
3	GP3	32	32.5	Concentration	4.30E+01	ug/L	1.06E+01	-0.3	
4	GP3	33	33.5	Concentration	3.80E+01	ug/L	1.06E+01	0.0	
5	GP3	33.5	34	Concentration	5.10E+01	ug/L	1.06E+01	0.0	
5	GP3	29	34	Concentration	4.00E+01	ug/L	1.06E+01	0.0	
7	GP8	29	33.5	Concentration	3.30E+01	ug/L	1.06E+01	0.0	
8	End of Transect		00.0	Concentration	0.00E+00	ug/L	1.06E+01	0.0	

Top of Bottom of Value Point and Selected Point to	Total Mass Flux Parameter Value Sampling Parameter Removed For Parameter Value Sampling Parameter Removed For Parameter Parameter Point and Selected Point to Interpolating Total Mass Flux Excluding Selected Point and Selected Point to Total Mass Flux							DEC	II TS
End of Transect Interval Interval Examined Analysis Units (g/day) (¼)	d of Transect Interval Examined Analysis Units (gddsy) (19)		Sampling	Sampling	Parameter	Value Removed For	Parameter	Total Mass Flux Excluding Selected Point and Interpolating	Contribution of Selected Point to Total Mass Flux
		End of Transect	Interval	Interval	Examined	Analysis	Units	(g/day)	(%)

Site Location and I.D.:
Description:

Next Step:

Mass Flux Summary

Back to Mass Flux Result

Back to Data Input

INSTRUCTIONS

1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darcy velocity and gradient input data.

2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

SELECT TRANSECT TO VIEW SELECT TIME PERIOD TO VIEW

Transect 1 ▼ 1

TCE Interpolation Methods

Hydraulic Conductivity: 1) Vertical: Linear 2) Horizontal: Linear Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: 1) Vertical: Linear 2) Horizontal: Linear

Total Mass Flux Including All Points

2.99E+01 (g/day)

Print

HELP

							RESU	JLTS
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)
, –	Start of Transect			Conductivity	5.00E-03	ft/d	2.99E+01	0.0
2	GP5	29.0	34.0	Conductivity	5.00E-03	ft/d	3.00E+01	-0.4
3	MW-11	30.0	36.0	Conductivity	1.19E+01	ft/d	2.97E+01	0.6
4	GP6	29.0	31.0	Conductivity	5.00E-03	ft/d	3.01E+01	-0.8
5	GP6	31.0	31.5	Conductivity	2.57E+01	ft/d	2.95E+01	1.3
3	GP6	32.0	32.2	Conductivity	2.57E+01	ft/d	2.99E+01	0.0
ź	GP6	33.0	33.5	Conductivity	2.57E+01	ft/d	2.99E+01	0.0
3	GP6	29.0	34.0	Conductivity	2.01E+01	ft/d	2.99E+01	0.0
9	GP11	29.0	31.0	Conductivity	5.00E-03	ft/d	3.08E+01	-3.2
5	GP11	31.0	35.0	Conductivity	3.98E+01	ft/d	2.80E+01	6.4
1	GP4	29.0	30.0	Conductivity	5.00E-03	ft/d	3.05E+01	-2.1
2	GP4	30.0	30.5	Conductivity	5.40E+01	ft/d	2.55E+01	14.6
3	GP4	31.0	31.5	Conductivity	5.00E-02	ft/d	2.99E+01	0.0
1	GP4	32.0	32.5	Conductivity	5.00E-03	ft/d	2.99E+01	0.0
5	GP4	33.0	33.5	Conductivity	5.40E+01	ft/d	2.99E+01	0.0
3	GP4	34.0	34.5	Conductivity	5.00E-03	ft/d	2.99E+01	0.0
7	GP4	29.0	34.5	Conductivity	5.00E-03	ft/d	2.99E+01	0.0
3	MW-12	29.0	34.0	Conductivity	9.62E+02	ft/d	9.42E+00	68.5
9	GP7	29.0	31.0	Conductivity	5.00E-03	ft/d	3.00E+01	-0.5
	GP7	31.0	31.5	Conductivity	1.66E+02	ft/d	2.96E+01	0.9
1	GP7	32.0	32.5	Conductivity	5.00E-03	ft/d	2.99E+01	0.0
2	GP7	33.0	33.5	Conductivity	1.66E+02	ft/d	2.99E+01	0.0
3	GP7	33.8	34.3	Conductivity	4.68E+02	ft/d	2.99E+01	0.0
1	GP7	29.0	34.3	Conductivity	5.00E-03	ft/d	2.99E+01	0.0
5	GP3	29.0	32.0	Conductivity	5.00E-03	ft/d	2.99E+01	-0.1
3	GP3	32.0	32.5	Conductivity	3.50E+01	ft/d	2.99E+01	0.1
7	GP3	33.0	33.5	Conductivity	5.01E+01	ft/d	2.99E+01	0.0
3	GP3	33.5	34	Conductivity	2.64E+01	ft/d	2.99E+01	0.0
j –	GP3	29	34	Conductivity	5.00E-03	ft/d	2.99E+01	0.0
5	MW-7	29	34.5	Conductivity	1.19E+02	ft/d	2.99E+01	-0.1
1	GP8	29	33.5	Conductivity	5.00E-03	ft/d	2.99E+01	-0.1
2	End of Transect			Conductivity	5.00E-03	ft/d	2.99E+01	0.0
3	Start of Transect			Concentration	0.00E+00	ug/L	2.99E+01	0.0
1	GP5	29	34	Concentration	1.20E+03	ug/L	2.99E+01	0.1
5	MW-11	30	36	Concentration	1.75E+03	ug/L	2.96E+01	1.0
3	GP6	29	31	Concentration		ug/L	2.99E+01	0.0
7	GP6	31	31.5	Concentration	7.10E+02	ug/L	3.04E+01	-1.8
3	GP6	32	32.2	Concentration	5.60E+02	ug/L	2.99E+01	0.0
9	GP6	33	33.5	Concentration	1.75E+03	ug/L	2.99E+01	0.0
	GP6	29	34	Concentration	3.90E+03	ug/L	2.99E+01	0.0
1	GP11	29	31	Concentration		ug/L	2.99E+01	0.0
2	GP11	31	35	Concentration	2.90E+03	ug/L	2.96E+01	0.8
3	GP4	29	30	Concentration		ug/L	2.99E+01	0.0
1	GP4	30	30.5	Concentration	4.70E+03	ug/L	1.36E+01	54.6
5	GP4	31	31.5	Concentration	1.50E+03	ug/L	2.99E+01	0.0
3	GP4	32	32.5	Concentration		ug/L	2.99E+01	0.0
ź 🗀	GP4	33	33.5	Concentration	5.40E+03	ug/L	2.99E+01	0.0
3	GP4	34	34.5	Concentration		ug/L	2.99E+01	0.0
9	GP4	29	34.5	Concentration	2.40E+03	ug/L	2.99E+01	0.0
5	MW-12	29	34	Concentration	1.30E+02	ug/L	6.27E+01	-110.0
1	GP7	29	31	Concentration		ug/L	2.99E+01	0.0
2	GP7	31	31.5	Concentration	1.00E+02	ug/L	2.99E+01	0.1
3	GP7	32	32.5	Concentration	1.10E+02	ug/L	2.99E+01	0.0
1	GP7	33	33.5	Concentration	5.20E+01	ug/L	2.99E+01	0.0
5	GP7	33.8	34.3	Concentration	3.80E+01	ug/L	2.99E+01	0.0
3	GP7	29	34.3	Concentration		ug/L	2.99E+01	0.0
7	GP3	29	32	Concentration		ug/L	2.99E+01	0.0
3	GP3	32	32.5	Concentration	4.30E+01	ug/L	3.00E+01	-0.2
9	GP3	33	33.5	Concentration	3.80E+01	ug/L	2.99E+01	0.0
5	GP3	33.5	34	Concentration	5.10E+01	ug/L	2.99E+01	0.0
1	GP3	29	34	Concentration	4.00E+01	ug/L	2.99E+01	0.0
2	MW-7	29	34.5	Concentration	1.40E+02	ug/L	2.97E+01	0.6
3	GP8	29	33.5	Concentration	3.30E+01	ug/L	2.99E+01	0.0
1	End of Transect			Concentration	0.00E+00	ug/L	2.99E+01	0.0

Top of Bottom of Value Point and Selected Point to	Total Mass Flux Parameter Value Sampling Parameter Removed For Parameter Value Sampling Parameter Removed For Parameter Parameter Point and Selected Point to Interpolating Total Mass Flux Excluding Selected Point and Selected Point to Total Mass Flux							DEC	II TS
End of Transect Interval Interval Examined Analysis Units (g/day) (¼)	d of Transect Interval Examined Analysis Units (gddsy) (19)		Sampling	Sampling	Parameter	Value Removed For	Parameter	Total Mass Flux Excluding Selected Point and Interpolating	Contribution of Selected Point to Total Mass Flux
		End of Transect	Interval	Interval	Examined	Analysis	Units	(g/day)	(%)

Site Location and I.D.:
Description:

CAMP LEJEUNE SITE 89 - DIRECT PUSH SAMPLING

INSTRUCTIONS

1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darry velocity and gradient input data.

2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

RESULTS

Next Step: Mass Flux Summary Back to Mass Flux Result Back to Data Input

Print HELP

SELECT TRANSECT TO VIEW SELECT TIME PERIOD TO VIEW

Transect 1 ▼ 1

TCE Interpolation Methods

Hydraulic Conductivity: 1) Vertical: Linear 2) Horizontal: Linear Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: Nearest Neighbor

Total Mass Flux Including All Points

9.10E+01 (g/day)

_							RESU	ILIS
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)
1	Start of Transect			Conductivity	1.67E+00	ft/d	9.11E+01	-0.1
2	GP 6	9.0	9.5	Conductivity	1.67E+00	ft/d	1.31E+02	-44.3
3	GP 6	13.0	13.5	Conductivity	1.67E+00	ft/d	9.10E+01	0.0
4	GP 6	17.0	17.5	Conductivity	1.88E+01	ft/d	8.30E+01	8.8
5	GP 6	17.0	17.5	Conductivity	7.89E+00	ft/d	9.13E+01	-0.4
6	GP 6	21.0	21.5	Conductivity	4.23E+01	ft/d	8.77E+01	3.6
7	GP 6	21.0	21.5	Conductivity	9.45E-01	ft/d	9.10E+01	0.0
8	GP 6	23.0	23.5	Conductivity	9.17E-01	ft/d	9.09E+01	0.1
9	GP 6	25.0	25.5	Conductivity	8.02E-01	ft/d	9.01E+01	1.0
10	GP 6	29.0	29.5	Conductivity	1.31E-01	ft/d	9.24E+01	-1.5
11	GP 6	29.0	29.5	Conductivity	1.72E+00	ft/d	9.10E+01	0.0
12	GP 6	33.0	33.5	Conductivity	1.72E+00	ft/d	9.10E+01	0.0
13	GP 6	37.0	37.5	Conductivity	5.96E-01	ft/d	9.10E+01	0.0
14	GP 5	11.0	11.5	Conductivity	6.48E-01	ft/d	9.10E+01	0.0
15	GP 5	13.0	13.5	Conductivity	8.77E-01	ft/d	9.10E+01	0.0
16	GP 5	17.0	17.5	Conductivity	1.04E+00	ft/d	9.10E+01	0.0
17	GP 5	21.0	21.5	Conductivity	2.75E-01	ft/d	9.10E+01	0.0
18	GP 5 GP 5	25.0	25.5	Conductivity	1.28E+00	ft/d	9.02E+01 9.13E+01	0.9
19		25.0	25.5	Conductivity	5.96E-01	ft/d	9.13E+01 9.10E+01	-0.4 0.0
20	GP 5 GP 5	29.0 33.0	29.5 33.5	Conductivity	1.38E+00	ft/d ft/d	9.10E+01 9.10E+01	0.0
21	GP 5	33.0	37.5	Conductivity	1.11E+00		9.10E+01 9.10E+01	0.0
22	GP 2	3.0	37.5	Conductivity Conductivity	1.11E+00 9.36E-01	ft/d ft/d	9.10E+01 9.10E+01	0.0
23	GP 2	9.0	9.5			ft/d	9.10E+01 9.10E+01	0.0
24 25	GP 2	13.0	13.5	Conductivity Conductivity	2.43E+00 8.10E-02	ft/d	9.10E+01 9.10E+01	0.0
25 <u> </u>	GP 2	17.0	17.5	Conductivity	5.20E-02	ft/d	9.10E+01 9.10E+01	0.0
27	GP 2	21.0	21.5	Conductivity	6.95E+00	ft/d	8.17E+01	10.3
28	GP 2	25	25.5	Conductivity	4.54E-01	ft/d	9.20E+01	-1.1
20 <u> </u>	GP 2	29	29.5	Conductivity	4.54E-01	ft/d	9.10E+01	0.0
30	GP 2	33	33.5	Conductivity	1.70E-01	ft/d	9.10E+01	0.0
31	GP 2	33	33.5	Conductivity	3.79E-01	ft/d	9.10E+01	0.0
32	GP 2	37	37.5	Conductivity	8.15E-01	ft/d	9.11E+01	-0.0
33	GP 1	9	9.5	Conductivity	2.75E+01	ft/d	9.10E+01	0.0
34	GP 1	15	15.5	Conductivity	3.07E+00	ft/d	9.10E+01	0.0
35	GP 1	15	15.5	Conductivity	3.07E+00	ft/d	9.10E+01	0.0
36	GP 1	19	19.5	Conductivity	5.20E-02	ft/d	9.11E+01	-0.1
37	GP 1	23	23.5	Conductivity	2.99E+00	ft/d	9.20E+01	-1.1
38	GP 1	27	27.5	Conductivity	3.93E+00	ft/d	7.75E+01	14.8
39	GP 1	31	31.5	Conductivity	2.13E-01	ft/d	9.70E+01	-6.6
40	GP 1	35	35.5	Conductivity	2.56E-01	ft/d	9.13E+01	-0.3
41	GP 1	35	35.5	Conductivity	9.11E-01	ft/d	9.14E+01	-0.4
42	GP 1	39	39.5	Conductivity	1.93E+00	ft/d	9.11E+01	-0.1
13	GP 3	39	39.5	Conductivity	4.05E+00	ft/d	9.10E+01	0.0
14	GP 3	6	6.5	Conductivity	4.05E+00	ft/d	9.10E+01	0.0
1 5	GP 3	17	17.5	Conductivity	2.00E+00	ft/d	9.10E+01	0.0
46	GP 3	21	21.5	Conductivity	3.21E-01	ft/d	9.11E+01	-0.1
17	GP 3	25	25.5	Conductivity	1.93E-01	ft/d	1.09E+02	-19.2
48	GP 3	25	25.5	Conductivity	2.62E-01	ft/d	9.10E+01	0.0
19	GP 3	29	29.5	Conductivity	2.44E+00	ft/d	8.26E+01	9.2
50	GP 3	33	33.5	Conductivity	8.46E-01	ft/d	9.12E+01	-0.2
51	GP 3	37	37.5	Conductivity	1.69E-01	ft/d	9.14E+01	-0.4
52	GP 4	3	3.5	Conductivity	1.69E-01	ft/d	9.10E+01	0.0
53	GP 4	6	6.5	Conductivity	7.28E-01	ft/d	9.10E+01	0.0
54	GP 4	9	9.5	Conductivity	1.75E+00	ft/d	9.10E+01	0.0
55	GP 4	13	13.5	Conductivity	2.03E+00	ft/d	9.10E+01	0.0
56	GP 4	17	17.5	Conductivity	3.42E+00	ft/d	8.24E+01	9.5
57	GP 4	17	17.5	Conductivity	9.17E-01	ft/d	9.43E+01	-3.6
58	GP 4	21	21.5	Conductivity	3.03E+00	ft/d	8.95E+01	1.7
59	GP 4	25	25.5	Conductivity	3.03E+00	ft/d	9.10E+01	0.0
50	GP 4	29	29.5	Conductivity	2.19E-01	ft/d	9.19E+01	-1.0
51	GP 4	33	33.5	Conductivity	2.19E-01	ft/d	9.10E+01	0.0
62	GP 4	37	37.5	Conductivity	8.53E-01	ft/d	9.10E+01	0.0
63	GP 7	8	12	Conductivity	1.30E+00	ft/d	9.09E+01	0.1
64	GP 7	8	12	Conductivity	1.12E+00	ft/d	9.10E+01	0.0
65	GP 7	12	16	Conductivity	1.12E+00	ft/d	9.10E+01	0.0
56	GP 7	16	20	Conductivity	1.01E+00	ft/d	9.10E+01	0.0
67	GP 7	20	24	Conductivity	2.80E+00	ft/d	9.10E+01	0.0

							RESU	JLTS
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)
38	End of Transect			Conductivity	2.80E+00	ft/d	9.10E+01	0.0
59	Start of Transect			Concentration	0.00E+00	ug/L	9.12E+01	-0.2
70	GP 6	9	9.5	Concentration	7.60E+04	ug/L	8.99E+01	1.2
71	GP 6	13	13.5	Concentration	7.40E+04	ug/L	9.10E+01	0.0
72	GP 6	17	17.5	Concentration	4.40E+04	ug/L	9.01E+01	1.0
73	GP 6	17	17.5	Concentration	6.60E+02	ug/L	9.41E+01	-3.4
74	GP 6 GP 6	21 21	21.5	Concentration Concentration	3.80E+02	ug/L	9.16E+01	-0.7 -5.5
75 <u> </u>	GP 6	23	21.5 23.5	Concentration	1.00E+00 1.50E+05	ug/L ug/L	9.60E+01 8.90E+01	2.2
77	GP 6	25	25.5	Concentration	1.60E+05	ug/L ug/L	8.96E+01	1.6
78	GP 6	29	29.5	Concentration	5.80E+04	ug/L	9.26E+01	-1.7
79	GP 6	29	29.5	Concentration	4.50E+02	ug/L	9.44E+01	-3.7
30	GP 6	33	33.5	Concentration	4.60E+02	ug/L	9.10E+01	0.0
31	GP 6	37	37.5	Concentration	6.60E+02	ug/L	9.34E+01	-2.7
32	GP 5	11	11.5	Concentration	2.00E+04	ug/L	8.79E+01	3.4
33	GP 5	13	13.5	Concentration	8.70E+02	ug/L	9.25E+01	-1.7
34	GP 5	17	17.5	Concentration	6.40E+01	ug/L	9.12E+01	-0.2
35	GP 5	21	21.5	Concentration	2.90E+02	ug/L	9.10E+01	0.1
36	GP 5	25	25.5	Concentration	8.50E+01	ug/L	9.11E+01	-0.1
37	GP 5	25	25.5	Concentration	1.10E+03	ug/L	9.10E+01	0.1
38	GP 5	29	29.5	Concentration	5.80E+02	ug/L	9.10E+01	0.0
39	GP 5	33	33.5	Concentration	1.20E+02	ug/L	9.10E+01	0.0
90	GP 5 GP 2	37 3	37.5 3.5	Concentration Concentration	1.30E+02 4.90E+01	ug/L	9.10E+01 9.10E+01	0.0
91	GP 2	9	9.5	Concentration	6.40E+01	ug/L ug/L	9.10E+01 9.10E+01	0.0
93	GP 2	13	13.5	Concentration	2.90E+02	ug/L ug/L	9.10E+01	0.0
94	GP 2	17	17.5	Concentration	7.50E+02	ug/L	9.10E+01	0.0
95	GP 2	21	21.5	Concentration	1.20E+03	ug/L	9.08E+01	0.2
96	GP 2	25	25.5	Concentration	6.20E+02	ug/L	9.10E+01	0.0
97	GP 2	29	29.5	Concentration	5.40E+02	ug/L	9.10E+01	0.0
98	GP 2	33	33.5	Concentration	6.20E+02	ug/L	9.10E+01	0.0
99	GP 2	33	33.5	Concentration	6.80E+01	ug/L	9.10E+01	0.0
00	GP 2	37	37.5	Concentration	3.00E+00	ug/L	9.10E+01	0.0
01	GP 1	9	9.5	Concentration	2.00E+01	ug/L	9.10E+01	0.0
)2	GP 1	15	15.5	Concentration	7.20E+01	ug/L	9.10E+01	0.0
)3	GP 1	15	15.5	Concentration	1.10E+02	ug/L	9.10E+01	0.0
04	GP 1	19	19.5	Concentration	7.30E+02	ug/L	9.10E+01	0.0
)5	GP 1	23	23.5	Concentration	5.80E+01	ug/L	1.10E+02	-21.4
06 07	GP 1 GP 1	27 31	27.5 31.5	Concentration Concentration	1.80E+05 1.50E+05	ug/L	7.91E+01 9.01E+01	13.0 1.0
08	GP 1	35	35.5	Concentration	4.20E+04	ug/L ug/L	9.25E+01	-1.6
9	GP 1	35	35.5	Concentration	4.40E+03	ug/L	9.13E+01	-0.4
10	GP 1	39	39.5	Concentration	1.20E+03	ug/L	9.10E+01	0.0
11	GP 3	39	39.5	Concentration	1.10E+02	ug/L	9.11E+01	-0.1
12	GP 3	6	6.5	Concentration	2.70E+01	ug/L	9.10E+01	0.0
13	GP 3	17	17.5	Concentration	3.00E+01	ug/L	9.10E+01	0.0
14	GP 3	21	21.5	Concentration	4.20E+02	ug/L	9.10E+01	0.0
15	GP 3	25	25.5	Concentration	1.10E+05	ug/L	8.97E+01	1.4
16	GP 3	25	25.5	Concentration	1.10E+05	ug/L	9.10E+01	0.0
17	GP 3	29	29.5	Concentration	9.40E+04	ug/L	9.11E+01	-0.1
18	GP 3	33	33.5	Concentration	7.90E+04	ug/L	8.98E+01	1.3
19	GP 3	37	37.5	Concentration	2.80E+04	ug/L	9.12E+01	-0.2
20	GP 4	3	3.5	Concentration	2.70E+04	ug/L	9.10E+01	0.0
21	GP 4	6	6.5	Concentration	1.70E+02	ug/L	9.15E+01	-0.5 0.0
22	GP 4 GP 4	9 13	9.5 13.5	Concentration Concentration	5.10E+02 1.90E+02	ug/L ug/L	9.10E+01 9.10E+01	0.0
24	GP 4	17	17.5	Concentration	1.20E+05		8.91E+01	2.1
25	GP 4	17	17.5	Concentration	9.40E+04	ug/L ug/L	9.05E+01	0.5
26	GP 4	21	21.5	Concentration	3.80E+03	ug/L	9.42E+01	-3.6
27	GP 4	25	25.5	Concentration	3.60E+03	ug/L	9.10E+01	0.0
28	GP 4	29	29.5	Concentration	2.30E+03	ug/L	9.10E+01	0.0
29	GP 4	33	33.5	Concentration	5.70E+02	ug/L	9.10E+01	0.0
30	GP 4	37	37.5	Concentration	2.10E+03	ug/L	9.10E+01	0.0
31	GP 7	8	12	Concentration	5.20E+03	ug/L	9.10E+01	0.1
32	GP 7	8	12	Concentration	1.80E+03	ug/L	9.10E+01	0.0
33	GP 7	12	16	Concentration	1.80E+03	ug/L	9.10E+01	0.0
34	GP 7	16	20	Concentration	1.40E+02	ug/L	9.10E+01	0.0
35	GP 7	20	24	Concentration	3.20E+01	ug/L	9.10E+01	0.0

Interpolation Error Results Site Location and I.D.: Ft. Lewis NAPL Area 3 Description: Ft. Lewis naple Area 3 Description: Ft. Lewis naple Area 3 Ft. Lewis naple Area 3 Description: INSTRUCTIONS 1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darcy velocity and gradient input data. 2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

Next Step:

Mass Flux Summary

Back to Mass Flux Result

Back to Data Input

HELP

SELECT TRANSECT TO VIEW
SELECT TIME PERIOD TO VIEW

Transect 1 2

TCE Interpolation Methods

Hydraulic Conductivity: Uniform Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: Uniform

Total Mass Flux Including All Points

4.31E+00 (g/day)

_							RESU	JLTS
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)
1	Start of Transect			Concentration	0.00E+00	ug/L	0.00E+00	100.0
2	FX3-06	9.0	40.0	Concentration	1.30E+02	ug/L	0.00E+00	100.0
3	FX3-04	9.0	40.0	Concentration	5.50E+01	ug/L	0.00E+00	100.0
4	FX3-01	9.0	40.0	Concentration	5.20E+01	ug/L	0.00E+00	100.0
5	FX3-02	9.0	40.0	Concentration	2.20E+02	ug/L	0.00E+00	100.0
6	End of Transect			Concentration	0.00E+00	ug/L	0.00E+00	100.0

Interpolation Error Results Site Location and I.D.: Description: Ft. Lewis NAPL Area 3 Description: INSTRUCTIONS 1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darcy velocity and gradient input data. 2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

Next Step:

Mass Flux Summary

Back to Mass Flux Result

Back to Data Input

HELP

SELECT TRANSECT TO VIEW
SELECT TIME PERIOD TO VIEW

Transect 1 2

TCE Interpolation Methods

Hydraulic Conductivity: Uniform Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: Uniform

Total Mass Flux Including All Points

3.90E-01 (g/day)

					·		RESU	JLTS
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)
1	Start of Transect			Concentration	0.00E+00	ug/L	0.00E+00	100.0
2	FX3-06	9.0	40.0	Concentration	1.30E+02	ug/L	0.00E+00	100.0
3	FX3-04	9.0	40.0	Concentration	5.50E+01	ug/L	0.00E+00	100.0
4	FX3-01	9.0	40.0	Concentration	5.20E+01	ug/L	0.00E+00	100.0
5	FX3-02	9.0	40.0	Concentration	2.20E+02	ug/L	0.00E+00	100.0
6	End of Transect			Concentration	0.00E+00	ug/L	0.00E+00	100.0

Site Location and I.D.:
Description: Ft. Lewis NAPL Area 3

Back to Mass Flux Result

Back to Data Input

INSTRUCTIONS

1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darcy velocity and gradient input data.

2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

Print HELP

SELECT TRANSECT TO VIEW SELECT TIME PERIOD TO VIEW Transect 1 2

TCE Interpolation Methods

Next Step:

Mass Flux Summary

Hydraulic Conductivity: Uniform

Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: Uniform

Total Mass Flux Including All Points

1.50E+00 (g/day)

					·		RESU	JLTS
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)
1	Start of Transect			Concentration	0.00E+00	ug/L	1.70E+00	-13.4
2	FX3-06	9.0	40.0	Concentration	1.30E+02	ug/L	1.14E+00	24.0
3	FX3-04	9.0	40.0	Concentration	5.50E+01	ug/L	1.64E+00	-9.7
4	FX3-01	9.0	40.0	Concentration	5.20E+01	ug/L	1.80E+00	-20.3
5	FX3-02	9.0	40.0	Concentration	2.20E+02	ug/L	9.39E-01	37.4
6	End of Transect			Concentration	0.00E+00	ug/L	1.81E+00	-20.7

Site Location and I.D.:
Description:

Hunter AAF Former Pumphouse #2

Back to Mass Flux Result

Back to Data Input

- INSTRUCTIONS

 1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darcy velocity and gradient input data.

 2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

SELECT TRANSECT TO VIEW SELECT TIME PERIOD TO VIEW

Transect 1 ▼ 1

Next Step: Mass Flux Summary

Benzene Interpolation Methods

Hydraulic Conductivity: 1) Vertical: Linear 2) Horizontal: Linear Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: Nearest Neighbor

Total Mass Flux Including All Points

1.03E-01

Print

HELP

_				1.03E-01 (g/day)			RESULTS		
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)	
1	Start of Transect	40.0	40.5	Conductivity	3.80E+00	ft/d	1.03E-01	0.0	
2	GP 2 GP 2	13.0 14.0	13.5 14.5	Conductivity	3.80E+00	ft/d ft/d	1.03E-01 1.03E-01	-0.1 0.0	
3	GP 2	16.0	16.5	Conductivity Conductivity	1.30E+01 1.60E+01	ft/d	1.03E-01	0.0	
<i>4</i> 5	GP 2	18.0	18.5	Conductivity	5.30E+00	ft/d	1.03E-01	-0.1	
6	GP 2	20.0	20.5	Conductivity	1.60E+01	ft/d	1.03E-01	0.1	
7	GP 3	13.0	13.5	Conductivity	2.40E+00	ft/d	1.03E-01	-0.2	
8	GP 3	14.0	14.5	Conductivity	8.30E+00	ft/d	1.03E-01	0.0	
9	GP 3	16.0	16.5	Conductivity	1.10E+01	ft/d	1.03E-01	-0.1	
0	GP 3	18.0	18.5	Conductivity	2.40E+01	ft/d	1.03E-01	0.1	
1	GP 3	20.0	20.5	Conductivity	1.90E+01	ft/d	1.03E-01	-0.1	
2	GP 4	13.0	13.5	Conductivity	2.00E+01	ft/d	1.03E-01	0.0	
3	GP 4	14.0	14.5	Conductivity	2.40E+01	ft/d	1.03E-01	0.0	
4	GP 4 GP 4	16.0 18.0	16.5 18.5	Conductivity	2.30E+01 2.00E+01	ft/d ft/d	1.03E-01 1.03E-01	0.1 -0.1	
6	GP 4	20.0	20.5	Conductivity Conductivity	2.60E+01	ft/d	1.03E-01	0.1	
7	GP 5	13.0	13.5	Conductivity	4.10E+01	ft/d	1.03E-01	0.1	
8	GP 5	14.0	14.5	Conductivity	4.30E+01	ft/d	1.03E-01	0.0	
19	GP 5	16.0	16.5	Conductivity	3.10E+01	ft/d	1.03E-01	0.0	
0	GP 5	18.0	18.5	Conductivity	2.70E+01	ft/d	1.03E-01	-0.2	
1	GP 5	20.0	20.5	Conductivity	3.20E+01	ft/d	1.02E-01	0.3	
2	GP 55	14.0	14.5	Conductivity	1.50E+00	ft/d	1.06E-01	-3.7	
23	GP 55	15.0	15.5	Conductivity	7.50E+00	ft/d	1.03E-01	0.0	
24	GP 55	17.0	17.5	Conductivity	1.00E+01	ft/d	1.00E-01	2.2	
5	GP 55	19.0	19.5	Conductivity	8.50E+00	ft/d	1.02E-01	0.5	
6	GP 55	21.0	21.5	Conductivity	2.90E+00	ft/d	1.03E-01	-0.3	
7	GP 6	13.0	13.5	Conductivity	1.20E+01	ft/d	1.04E-01	-1.3	
8	GP 6	14	14.5	Conductivity	1.10E+01	ft/d	1.03E-01	0.0	
9	GP 6 GP 6	16	16.5	Conductivity Conductivity	1.40E+01	ft/d	9.68E-02 1.02E-01	5.7 0.7	
30 31	GP 6	18 20	18.5 20.5	Conductivity	1.10E+01 3.80E+00	ft/d ft/d	1.02E-01 1.03E-01	-0.6	
2	GP 65	13	13.5	Conductivity	2.50E+01	ft/d	1.03E-01	0.3	
3	GP 65	15	15.5	Conductivity	2.00E+01	ft/d	1.04E-01	-1.2	
4	GP 65	16	16.5	Conductivity	1.70E+01	ft/d	1.03E-01	0.0	
5	GP 65	18	18.5	Conductivity	2.30E+01	ft/d	1.02E-01	0.5	
36	GP 65	20	20.5	Conductivity	1.80E+01	ft/d	1.03E-01	-0.3	
37	GP 7	13	13.5	Conductivity	1.70E+01	ft/d	1.03E-01	-0.1	
8	GP 7	14	14.5	Conductivity	1.40E+01	ft/d	1.03E-01	0.0	
9	GP 7	16	16.5	Conductivity	1.90E+01	ft/d	1.03E-01	0.0	
0	GP 7	18	18.5	Conductivity	2.10E+01	ft/d	1.02E-01	0.5	
1	GP 7	20	20.5	Conductivity	1.10E+01	ft/d	1.10E-01 1.02E-01	-6.6 0.2	
2	GP 8 GP 8	13 14	13.5 14.5	Conductivity Conductivity	1.40E+01 8.80E+00	ft/d ft/d	1.02E-01 1.03E-01	0.2	
3	GP 8	16	16.5	Conductivity	9.80E+00	ft/d	1.04E-01	-1.2	
5	GP 8	18	18.5	Conductivity	2.20E+01	ft/d	9.80E-02	4.5	
6	GP 8	20	20.5	Conductivity	2.90E+00	ft/d	1.51E-01	-47.1	
7	GP 9	12	16	Conductivity	5.50E+00	ft/d	1.03E-01	-0.1	
8	GP 9	16	20	Conductivity	7.70E+00	ft/d	1.01E-01	1.3	
9	End of Transect			Conductivity	7.70E+00	ft/d	1.03E-01	0.0	
0	Start of Transect	1		Concentration	0.00E+00	ug/L	1.03E-01	0.0	
1	GP 2	13	13.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
2	GP 2	14	14.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
3	GP 2	16	16.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
4_	GP 2 GP 2	18 20	18.5 20.5	Concentration	5.00E-01	ug/L	1.03E-01 1.03E-01	0.0	
5 6	GP 3	13	13.5	Concentration Concentration	5.00E-01 1.00E+00	ug/L ug/L	1.03E-01 1.03E-01	0.0	
7	GP 3	14	14.5	Concentration	5.00E-01	ug/L ug/L	1.03E-01	0.0	
8	GP 3	16	16.5	Concentration	5.00E-01	ug/L	1.03E-01	-0.1	
9	GP 3	18	18.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
0	GP 3	20	20.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
1	GP 4	13	13.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
2	GP 4	14	14.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
3	GP 4	16	16.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
64	GP 4	18	18.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
55	GP 4	20	20.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
6	GP 5	13	13.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	
67	GP 5	14	14.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0	

							RESULTS	
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)
68	GP 5	16	16.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
69	GP 5	18	18.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
70	GP 5	20	20.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
71	GP 55	14	14.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
72	GP 55	15	15.5	Concentration	4.00E+00	ug/L	1.03E-01	0.0
73	GP 55	17	17.5	Concentration	5.00E-01	ug/L	1.06E-01	-3.6
74	GP 55	19	19.5	Concentration	1.70E+01	ug/L	9.81E-02	4.4
75	GP 55	21	21.5	Concentration	5.00E-01	ug/L	1.07E-01	-3.9
76	GP 6	13	13.5	Concentration	1.30E+01	ug/L	1.40E-01	-36.4
77	GP 6	14	14.5	Concentration	5.00E+00	ug/L	1.03E-01	0.0
78	GP 6	16	16.5	Concentration	1.96E+02	ug/L	4.87E-02	52.6
79	GP 6	18	18.5	Concentration	5.00E-01	ug/L	1.23E-01	-19.5
80	GP 6	20	20.5	Concentration	2.00E+00	ug/L	1.02E-01	0.3
81	GP 65	13	13.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
82	GP 65	15	15.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
83	GP 65	16	16.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
84	GP 65	18	18.5	Concentration	5.00E-01	ug/L	1.03E-01	-0.7
85	GP 65	20	20.5	Concentration	4.00E+00	ug/L	1.01E-01	1.2
86	GP 7	13	13.5	Concentration	3.00E+00	ug/L	1.02E-01	1.2
87	GP 7	14	14.5	Concentration	2.00E+00	ug/L	1.03E-01	0.0
88	GP 7	16	16.5	Concentration	5.00E-01	ug/L	1.03E-01	-0.6
89	GP 7	18	18.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
90	GP 7	20	20.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
91	GP 8	13	13.5	Concentration	5.00E-01	ug/L	1.05E-01	-1.9
92	GP 8	14	14.5	Concentration	5.00E-01	ug/L	1.03E-01	0.0
93	GP 8	16	16.5	Concentration	5.00E+00	ug/L	1.01E-01	1.2
94	GP 8	18	18.5	Concentration	4.00E+00	ug/L	1.20E-01	-17.3
95	GP 8	20	20.5	Concentration	6.50E+01	ug/L	8.12E-02	20.9
96	GP 9	12	16	Concentration	5.00E-01	ug/L	1.04E-01	-0.9
97	GP 9	16	20	Concentration	5.00E+00	ug/L	1.01E-01	1.5
98	End of Transect			Concentration	0.00E+00	ug/L	1.03E-01	-0.1

NAS Alameda Site 5 Site Location and I.D.:
Description:

INSTRUCTIONS

1. The table below shows all concentration and, if applicable, non-uniform conductivity/Darcy velocity and gradient input data.

2. During the uncertainty analysis, each of the points in the table are removed one at a time and the mass flux calculated without that point using the interpolation scheme specified in the Data Input section (note that

Back to Mass Flux Result Next Step: Mass Flux Summary Back to Data Input HELP

SELECT TRANSECT TO VIEW SELECT TIME PERIOD TO VIEW

Transect 1 ▼ 1

TCE Interpolation Methods

Hydraulic Conductivity: 1) Vertical: Linear 2) Horizontal: Linear Concentration: 1) Vertical: Linear 2) Horizontal: Linear Hydraulic Gradient: 1) Vertical: Linear 2) Horizontal: Linear

Total Mass Flux Including All Points

1.79E-01 (g/day)

Print

_	al Mass Flux Including All Points			1.79E-01 (g/day)			RESULTS		
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)	
1	Start of Transect	7.0	7.5	Conductivity	1.90E+01 1.90E+01	ft/d ft/d	1.80E-01 1.83E-01	-0.8 -2.8	
2 _	GP 1 GP 1	7.0 10.0	7.5 10.5	Conductivity Conductivity	6.60E+00	ft/d	1.83E-01 1.72E-01	3.8	
1	GP 1	13.0	13.5	Conductivity	3.10E+00	ft/d	1.86E-01	-4.4	
5	GP 1	16.0	16.5	Conductivity	6.40E-02	ft/d	1.87E-01	-4.9	
3	GP 1	19.0	19.5	Conductivity	1.10E+00	ft/d	1.86E-01	-4.2	
7 🗀	GP 1	21.0	21.5	Conductivity	5.10E-01	ft/d	1.86E-01	-4.2	
3	GP 2	7.0	7.5	Conductivity	1.60E+01	ft/d	1.81E-01	-1.4	
9	GP 2 GP 2	10.0 13.0	10.5 13.5	Conductivity	1.40E+00	ft/d	2.55E-01 1.56E-01	-42.8 12.5	
1	GP 2	17.0	17.5	Conductivity Conductivity	1.20E+01 5.10E-01	ft/d ft/d	1.94E-01	-8.6	
2	GP 2	19.0	19.5	Conductivity	8.40E+00	ft/d	1.86E-01	-4.0	
3	GP 2	21.0	21.5	Conductivity	2.70E-01	ft/d	1.89E-01	-5.7	
1	GP 3	6.5	7.0	Conductivity	1.60E+01	ft/d	1.86E-01	-4.2	
5	GP 3	9.5	10.0	Conductivity	9.60E+00	ft/d	1.60E-01	10.2	
3	GP 3	12.5	13.0	Conductivity	1.40E+00	ft/d	1.99E-01	-11.2	
<u> </u>	GP 3	15.5	16.0	Conductivity	1.80E+00	ft/d	1.84E-01	-3.2	
3 _	GP 3 GP 4	20.5	21.0	Conductivity	2.50E-01	ft/d ft/d	1.87E-01 1.77E-01	-4.5 0.6	
9	GP 4	6.5 9.5	7.0 10.0	Conductivity Conductivity	1.50E+01 4.30E+00	ft/d	1.77E-01 1.91E-01	-6.9	
1	GP 4	12.5	13.0	Conductivity	4.50E+00	ft/d	1.81E-01	-1.4	
5	GP 4	15.5	16.0	Conductivity	6.90E-01	ft/d	1.88E-01	-5.4	
3	GP 4	18.5	19.0	Conductivity	2.10E+00	ft/d	1.86E-01	-4.1	
1	GP 4	20.5	21.0	Conductivity	5.10E-01	ft/d	1.86E-01	-4.2	
5	GP 5	6.5	7.0	Conductivity	9.30E+00	ft/d	1.85E-01	-3.8	
3	GP 5	9.5	10.0	Conductivity	5.20E+00	ft/d	1.86E-01	-4.2	
7	GP 5	12.5	13.0	Conductivity	1.10E+00	ft/d	1.90E-01	-6.4	
3 _	GP 5 GP 5	15.5	16 19	Conductivity	1.50E+00	ft/d ft/d	1.87E-01 1.86E-01	-4.7 -4.2	
	GP 5	18.5 20.5	21	Conductivity Conductivity	4.40E+00 4.00E-01	ft/d	1.86E-01	-4.2	
1	GP 6	6.5	7	Conductivity	4.70E+01	ft/d	1.80E-01	-0.8	
-	GP 6	10.5	11	Conductivity	4.60E-01	ft/d	1.89E-01	-6.1	
3	GP 6	12.5	13	Conductivity	4.00E+00	ft/d	1.85E-01	-3.8	
1	GP 6	18.5	19	Conductivity	7.00E+00	ft/d	1.85E-01	-3.6	
5	GP 6	20.5	21	Conductivity	5.00E-01	ft/d	1.86E-01	-4.2	
5	GP 8	7	7.5	Conductivity	1.30E+01	ft/d	1.85E-01	-3.9	
7	GP 8	9.5	10 13	Conductivity	1.60E+00	ft/d ft/d	1.87E-01 1.75E-01	-4.8 1.8	
3 _	GP 8 GP 8	12.5 18.5	19	Conductivity Conductivity	1.90E+01 5.60E-01	ft/d	1.75E-01 1.89E-01	-5.8	
<u></u>	GP 8	20.5	21	Conductivity	9.70E-01	ft/d	1.86E-01	-4.2	
1	End of Transect			Conductivity	9.70E-01	ft/d	1.88E-01	-5.2	
2	Start of Transect			Concentration	0.00E+00	ug/L	2.07E-01	-16.2	
3	GP 1	7	7.5	Concentration	8.00E+00	ug/L	1.83E-01	-2.8	
1	GP 1	10	10.5	Concentration	3.40E+01	ug/L	1.70E-01	4.9	
5	GP 1	13	13.5	Concentration	1.35E+01	ug/L	1.89E-01	-5.7 -6.3	
3 7	GP 1 GP 1	16 19	16.5 19.5	Concentration Concentration	1.00E+00 0.00E+00	ug/L ug/L	1.90E-01 1.86E-01	-6.3 -4.3	
<u> </u>	GP 1	21	21.5	Concentration	0.00E+00	ug/L ug/L	1.86E-01	-4.3 -4.2	
	GP 2	7	7.5	Concentration	1.40E+01	ug/L	1.81E-01	-1.4	
	GP 2	10	10.5	Concentration	4.90E+01	ug/L	1.62E-01	9.4	
1	GP 2	13	13.5	Concentration	1.15E+01	ug/L	2.14E-01	-19.9	
2 🗀	GP 2	17	17.5	Concentration	0.00E+00	ug/L	1.88E-01	-5.6	
3 _	GP 2	19	19.5	Concentration	0.00E+00	ug/L	1.87E-01	-5.0	
1	GP 2 GP 3	21 6.5	21.5 7	Concentration	2.00E+00	ug/L	1.86E-01 1.86E-01	-4.1 -4.2	
5 _	GP 3	9.5	10	Concentration Concentration	0.00E+00 1.60E+01	ug/L ug/L	1.86E-01 1.93E-01	-4.2	
? -	GP 3	12.5	13	Concentration	2.10E+01	ug/L	1.79E-01	-0.4	
3	GP 3	15.5	16	Concentration	4.00E+00	ug/L	1.95E-01	-9.2	
,	GP 3	20.5	21	Concentration	0.00E+00	ug/L	1.88E-01	-5.3	
	GP 4	6.5	7	Concentration	9.00E+00	ug/L	1.75E-01	1.9	
1	GP 4	9.5	10	Concentration	1.00E+00	ug/L	1.97E-01	-10.3	
2	GP 4	12.5	13	Concentration	1.80E+01	ug/L	1.76E-01	1.6	
3	GP 4	15.5	16	Concentration	0.00E+00	ug/L	1.89E-01	-5.7	
4	GP 4 GP 4	18.5 20.5	19 21	Concentration	0.00E+00 0.00E+00	ug/L	1.86E-01 1.86E-01	-4.2 -4.2	
5 _	GP 4 GP 5	6.5	7	Concentration Concentration	1.00E+00	ug/L ug/L	1.86E-01	-4.2 -4.2	
,	GP 5	9.5	10	Concentration	1.00E+00	ug/L	1.92E-01	-7.5	

_							RESULTS		
	End of Transect	Top of Sampling Interval	Bottom of Sampling Interval	Parameter Examined	Parameter Value Removed For Analysis	Parameter Units	Total Mass Flux Excluding Selected Point and Interpolating (g/day)	Contribution of Selected Point to Total Mass Flux (%)	
68	GP 5	12.5	13	Concentration	1.60E+01	ug/L	1.79E-01	-0.5	
69	GP 5	15.5	16	Concentration	0.00E+00	ug/L	1.90E-01	-6.3	
70	GP 5	18.5	19	Concentration	0.00E+00	ug/L	1.86E-01	-4.2	
71	GP 5	20.5	21	Concentration	0.00E+00	ug/L	1.86E-01	-4.2	
72	GP 6	6.5	7	Concentration	1.00E+00	ug/L	1.81E-01	-1.5	
73	GP 6	10.5	11	Concentration	0.00E+00	ug/L	1.87E-01	-4.5	
74	GP 6	12.5	13	Concentration	0.00E+00	ug/L	1.86E-01	-4.2	
75	GP 6	18.5	19	Concentration	0.00E+00	ug/L	1.86E-01	-4.2	
76	GP 6	20.5	21	Concentration	0.00E+00	ug/L	1.86E-01	-4.2	
77	GP 8	7	7.5	Concentration	1.00E+00	ug/L	1.86E-01	-4.2	
78	GP 8	9.5	10	Concentration	1.00E+00	ug/L	1.87E-01	-4.9	
79	GP 8	12.5	13	Concentration	7.00E+00	ug/L	1.73E-01	2.9	
80	GP 8	18.5	19	Concentration	0.00E+00	ug/L	1.93E-01	-7.9	
81	GP 8	20.5	21	Concentration	0.00E+00	ug/L	1.86E-01	-4.2	
82	End of Transect			Concentration	0.00E+00	ug/L	1.89E-01	-5.6	
83	Start of Transect			Gradient	1.09E-01	ft/ft	1.87E-01	-4.5	
84	GP 1	7	7.5	Gradient	1.09E-01	ft/ft	1.83E-01	-2.8	
85	GP 1	10	10.5	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
86	GP 1	13	13.5	Gradient	1.09E-01	ft/ft	1.96E-01	-9.8	
87	GP 1	16	16.5	Gradient	3.92E-01	ft/ft	1.85E-01	-3.6	
88	GP 1	19	19.5	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2	
89	GP 1	21	21.5	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2	
90	GP 2	7	7.5	Gradient	1.09E-01	ft/ft	1.81E-01	-1.4	
91	GP 2	10	10.5	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
92	GP 2	13	13.5	Gradient	1.09E-01	ft/ft	2.03E-01	-13.5	
93	GP 2	17	17.5	Gradient	3.92E-01	ft/ft	1.85E-01	-3.6	
94	GP 2	19	19.5	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2	
95	GP 2	21	21.5	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2	
96	GP 3	6.5	7	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
97	GP 3	9.5	10	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
98	GP 3	12.5	13	Gradient	1.09E-01	ft/ft	1.97E-01	-10.5	
99	GP 3	15.5	16	Gradient	3.92E-01	ft/ft	1.84E-01	-2.8	
100	GP 3	20.5	21	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2	
101	GP 4	6.5	7	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
102	GP 4	9.5	10	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
103	GP 4	12.5	13	Gradient	1.09E-01	ft/ft	1.95E-01	-9.4	
104	GP 4	15.5	16	Gradient	3.92E-01	ft/ft	1.85E-01	-3.8	
105	GP 4	18.5	19	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2	
106	GP 4	20.5	21	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2	
107	GP 5	6.5	7	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
108	GP 5	9.5	10	Gradient	1.09E-01	ft/ft	1.86E-01	-4.2	
109	GP 5	12.5	13	Gradient	1.09E-01	ft/ft	1.90E-01 1.86E-01	-6.5 -4.0	
110	GP 5	15.5	16	Gradient	3.92E-01	ft/ft		-4.0 -4.2	
11	GP 5	18.5	19	Gradient	3.92E-01	ft/ft	1.86E-01		
112	GP 5	20.5	21	Gradient	3.92E-01	ft/ft	1.86E-01	-4.2 -4.2	
113	GP 6 GP 6	6.5	7	Gradient	1.09E-01	ft/ft ft/ft	1.86E-01 1.86E-01	-4.2 -4.2	
114	GP 6	10.5		Gradient	1.09E-01		1.86E-01 1.90E-01		
115	GP 6	12.5	13 19	Gradient	1.09E-01	ft/ft ft/ft	1.90E-01 1.85E-01	-6.4 -3.8	
116	GP 6	18.5	19 21	Gradient	3.92E-01 3.92E-01	ft/ft	1.85E-01 1.86E-01	-3.8 -4.2	
117	GP 6 GP 8	20.5		Gradient Gradient	3.92E-01 1.03E-02	ft/ft	1.86E-01 1.86E-01	-4.2 -4.2	
118	GP 8	7 9.5	7.5 10	Gradient Gradient	1.03E-02 1.03E-02	ft/ft	1.86E-01 1.86E-01	-4.2 -4.2	
119	GP 8 GP 8	9.5 12.5	10		1.03E-02 1.03E-02	ft/ft	1.86E-01 2.01E-01	-4.2 -12.3	
120	GP 8	12.5 18.5	13	Gradient Gradient	1.03E-02 3.92E-01	ft/ft	2.01E-01 1.84E-01	-12.3 -2.9	
121	GP 8 GP 8	18.5 20.5	19 21	Gradient Gradient	3.92E-01 3.92E-01	ft/ft	1.84E-01 1.86E-01	-2.9 -4.2	
122									